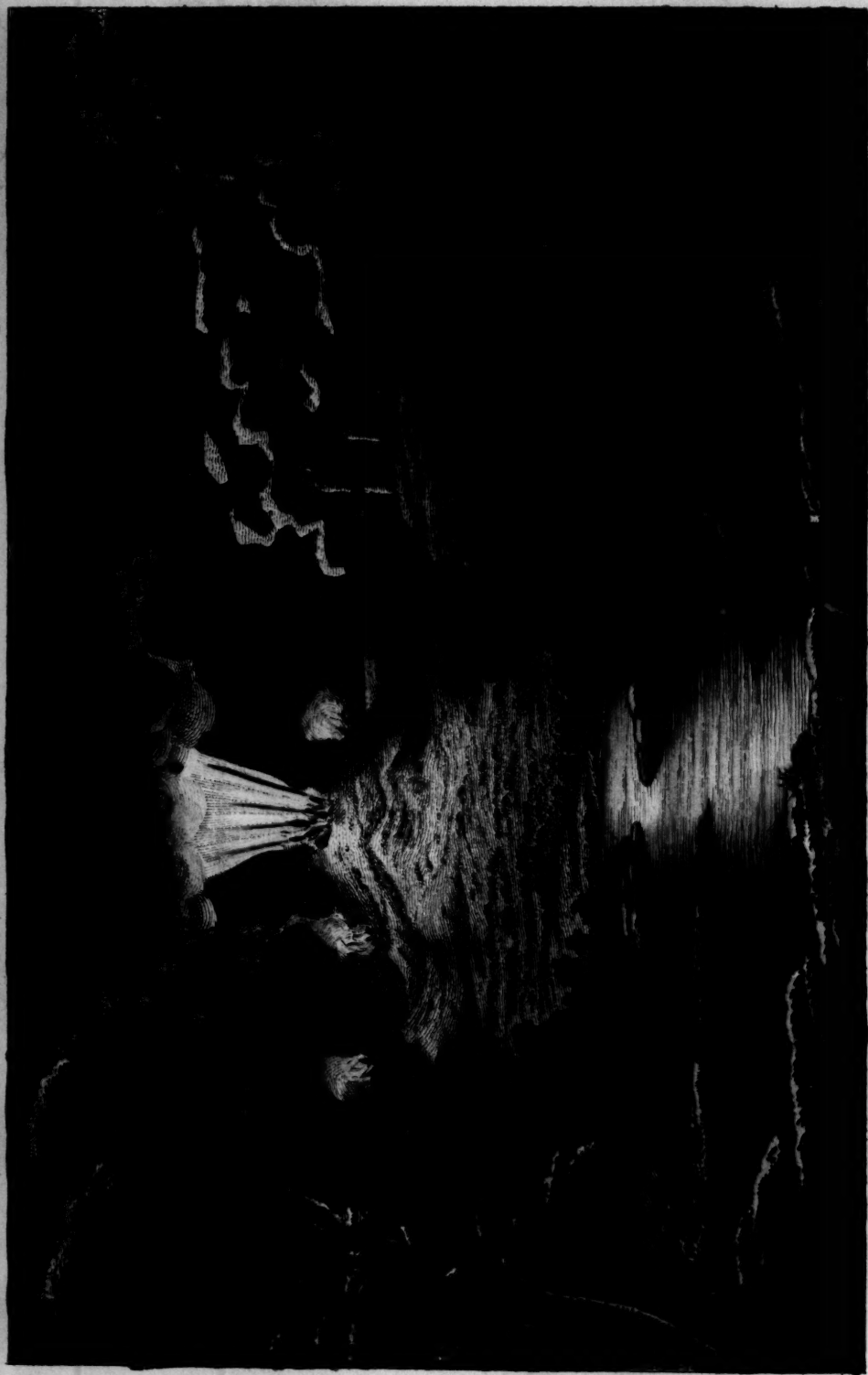
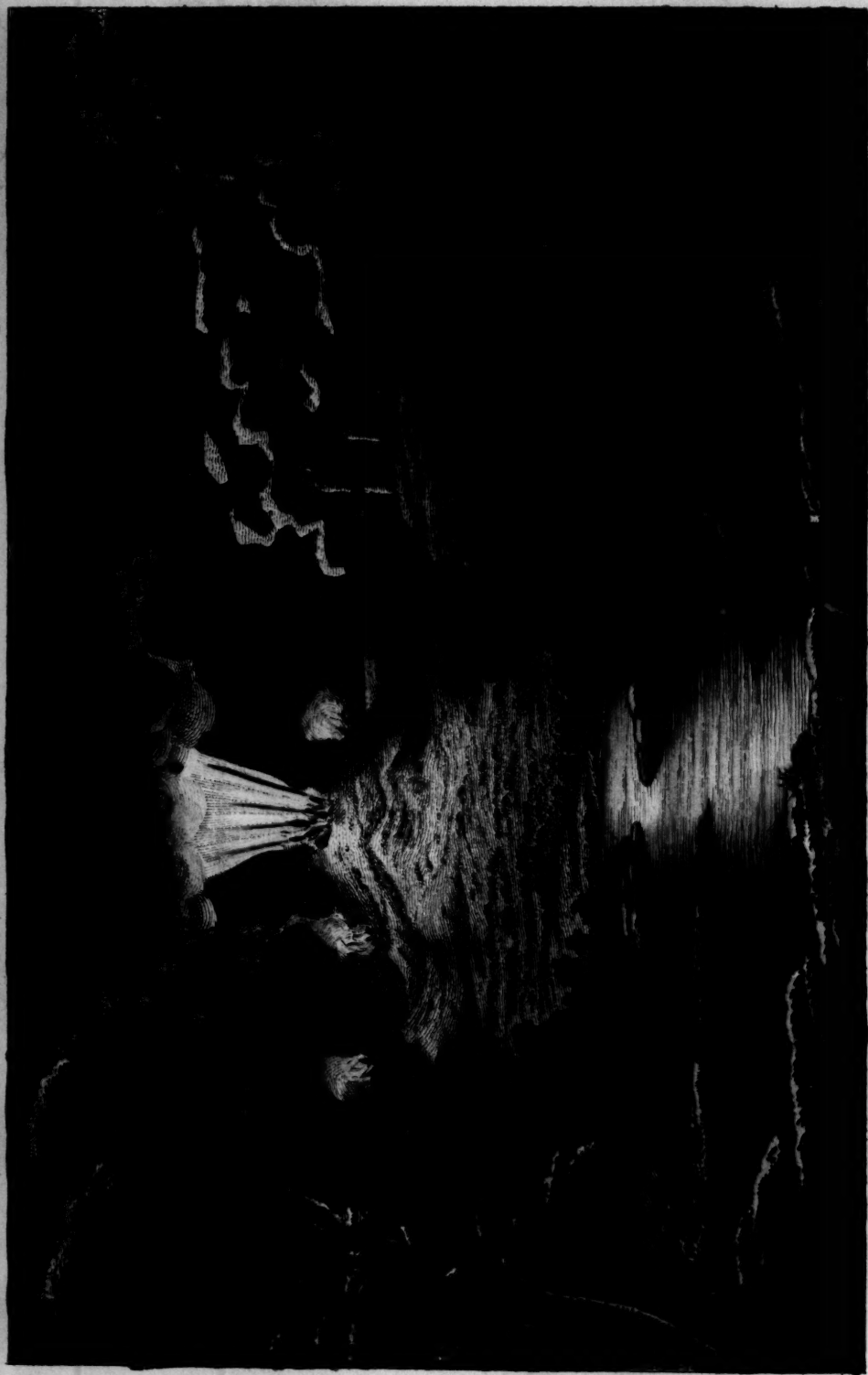




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HISTORICAL MISCELLANY
OF THE
CURIOSITIES AND RARITIES
IN
NATURE AND ART.

COMPRISING
NEW AND ENTERTAINING DESCRIPTIONS
OF THE MOST SURPRISING
VOLCANOS, CAVERNS, CATARACTS, WHIRLPOOLS, WATER-
FALLS, EARTHQUAKES, THUNDER, LIGHTNING,
AND OTHER WONDERFUL AND STUPENDOUS
PHENOMENA OF NATURE.
FORMING A RICH AND COMPREHENSIVE VIEW OF ALL
THAT IS INTERESTING AND CURIOUS
IN EVERY PART OF THE HABITABLE WORLD.

VOLUME THE SECOND.

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DIRECTIONS TO THE BINDER.

The Copper-plate View of the Volcano of Lipari, is to face the
Title, by way of Frontispiece to the Volume.



HISTORY.

HISTORY

OF THE

CURIOSITIES AND RARITIES

IN NATURE AND ART.

THE GROTTO OF ANTIPAROS.

ANTIPAROS is an island in the Archipelago, opposite to Paros, from which it is separated by a strait about seven miles over. It is the *Oleáros* mentioned by Strabo, Pliny, Virgil, &c. and was, according to Heraclides Ponticus, first peopled by a Phenician colony from Sidon.—According to Mr. Tournefort's account, it is about sixteen miles in circumference, produces a little wine and cotton, with as much corn as is necessary for the maintenance of sixty or seventy families, who live together in a village at one end of the island, and are mostly Maltese and French corsairs.

This island is remarkable for a subterraneous cavern or grotto, accounted one of the greatest natural curiosities in the world. It was first discovered in the last century by one Magni, an Italian traveller, who has given us the following account: "Having been informed by the natives of Paros, that in the little island of Antiparos, which lies about two miles from the former, a curious gigantic statue was to be seen at the mouth of a cavern in that place, it was resolved that we should pay it a visit. In pursuance of this resolution, after we had landed on the island, and walked about four miles through the midst of beautiful plains and sloping woodlands, we at length came to a little hill, on the side of which yawned a most horrible cavern, that with its gloom at first struck us with terror, and almost repressed curiosity. Recovering the first surprise, however, we entered boldly; and had not proceeded above twenty paces, when the supposed statue of the giant presented itself to our view. We quickly perceived, that what the ignorant natives had been terrified at as a giant, was

nothing more than a sparry concretion, formed by the water dropping from the roof of the cave, and by degrees hardening into a figure that their fears had formed into a monster. Incited by this extraordinary appearance, we were induced to proceed still farther, in quest of new adventures in this subterranean abode. As we proceeded, new wonders offered themselves: the spars, formed into trees and shrubs, presented a kind of petrified grove; some white, some green; and all receding in due perspective. They struck us with more amazement, as we knew them to be mere productions of nature, who, hitherto in solitude, had, in her playful moments, dressed the scene as if for her own amusement.

"But we had as yet seen but few of the wonders of the place, and we were introduced as yet only into the portico of this amazing temple. In one corner of this half-illuminated recess, there appeared an opening of about three feet wide, which seemed to lead to a place totally dark, and that one of the natives assured us contained nothing more than a reservoir of water. Upon this we tried, by throwing down some stones, which rumbled along the sides of the descent for some time, the sound seemed at last quashed in a bed of water. In order, however, to be more certain, we sent in a Levantine mariner, who, by the promise of a good reward, with a flambeau in his hand ventured into this narrow aperture. After continuing within it for about a quarter of an hour, he returned, carrying some beautiful pieces of white spar in his hand, which art could neither imitate nor equal. Upon being informed by him that the place was full of these beautiful incrustations, I ventured in once more with him, for about fifty paces, anxiously and cautiously descending by a steep and dangerous way. Finding, however, that we came to a precipice which led into a spacious amphitheatre, if I may so call it, still deeper than any other part, we returned; and being provided with a ladder, flambeaux, and other things to expedite our descent, our whole company, man by man, ventured into the same opening, and, descending one after another, we at last saw ourselves all together in the most magnificent part of the cavern.

"Our candles being now all lighted up, and the whole place completely illuminated, never could the eye be presented with a more glittering and magnificent scene. The roof all hung with solid icicles, transparent as glass, yet solid as marble. The eye could scarcely reach the lofty and noble ceiling; the sides were regularly formed with spars; and the whole presented the idea of a magnificent theatre, illuminated with an immense profusion of lights. The floor consisted of solid marble; and in several places, magnificent columns, thrones, altars, and other objects, appeared, as if nature had designed to mock the curiosities of art. Our voices, upon speaking or singing, were redoubled to an astonishing loudness; and, upon the firing of a gun, the noise and reverberations were almost deafening. In the midst of this grand amphitheatre rose a concretion of about fifteen feet high, that, in some measure, resembled an altar; from which, taking the hint, we caused masques to be celebrated there. The beautiful columns that shot up round the altar appeared like candlesticks; and many other natural objects represented the customary ornaments of this sacrament.

"Below even this spacious grotto, there seemed another cavern; down which I ventured with my former mariner, and descended about

about fifty paces by means of a rope. I at last arrived at a small spot of level ground where the bottom appeared different from that of the amphitheatre, being composed of soft clay, yielding to the pressure, and in which I thrust a stick to about six feet deep. In this, however, as above, numbers of the most beautiful crystals were formed; one of which, particularly, resembled a table. Upon our egress from this amazing cavern, we perceived a Greek inscription upon a rock at the mouth; but so obliterated by time, that we could not read it. It seemed to import, that one Antipater, in the time of Alexander, had come thither; but whether he penetrated into the depths of the cavern, he does not think fit to inform us."

From this account Mr. Tournefort's differs considerably. Mr. Magni mentions only one descent or precipice from the entry of the cave to the grotto, or most magnificent part: Mr. Tournefort says that there were many very dangerous precipices and rugged ways, through which they were obliged to pass sometimes on their back, and sometimes on their belly; but gives no particular account of his journey till he comes to the grand cavern. This indeed he describes very pompously; but as by it he evidently wants to support a favourite hypothesis, namely, the vegetation of stones, perhaps the particulars are not altogether to be depended upon. He informs us, that, at the entry into the cavern, he met with a Greek inscription almost defaced, containing a good number of proper names; and that there was a tradition among the inhabitants, that these were the names of some who had conspired against Alexander the Great, and, having missed their aim, had taken refuge in this grotto.

The most particular account, however, of this famous grotto that hath hitherto been published, we are favoured with in a letter signed *Charles Saunders*, and dated February 24th, 1746-7; which, as it is very particular, and seems to bear sufficient marks of authenticity, we shall here insert. "Its entrance lies in the side of a rock, about two miles from the sea-shore; and is a spacious and very large arch, formed of rough craggy rocks, over-hung with brambles and a great many climbing plants, that give it a gloominess which is very awful and agreeable. Our surgeon, myself, and four passengers, attended by six guides with lighted torches, entered this cavern about eight o'clock in the morning, in the middle of August last. We had not gone twenty yards in this cavity when we lost all sight of day-light: but, our guides going before us with lights, we entered into a low narrow kind of alley, surrounded every way with stones all glittering like diamonds by the light of our torches; the whole being covered and lined throughout with small crystals, which gave a thousand various colours by their different reflections. This alley grows lower and narrower as one goes on, till at length one can scarcely get along it. At the end of this passage we were each of us presented with a rope to tie about our middles; which when we had done, our guides led us to the brink of a most horrible precipice. The descent into this was quite steep, and the place all dark and gloomy. We could see nothing, in short, but some of our guides with torches in a miserable dark place, at a vast distance below us. The dreadful depth of this place, and the horror of the descent through a miserable darkness into it, made me look back to the lane of diamonds, if I may so call it, through which we had just passed; and I could not but think I was leaving heaven, to descend into the infernal regions.

The hope of something fine at my journey's end, tempted me, however, to trust myself to the rope and my guides at the top, to let myself down. After about two minutes dangling in this posture, not without much pain as well as terror, I found myself safe, however, at the bottom; and our friends all soon followed the example. When we had congratulated here with one another on our safe descent; I was enquiring where the grotto, as they called it, was. Our guides, shaking their heads, told us, we had a great way to that yet; and led us forward about thirty yards under a roof of ragged rocks, in a scene of terrible darkness, and at a vast depth from the surface of the earth, to the brink of another precipice much deeper and more terrible than the former. Two of the guides went down here with their torches first; and by their light we could see, that this passage was not so perpendicular indeed as the other, but lay in a very steep slant, with a very slippery rock for the bottom; vast pieces of rough rugged rocks jutting out in many places on the right hand, in the descent, and forcing the guides sometimes to climb over, sometimes to creep under them, and sometimes to go round them; and on the left, a thousand dark caverns, like so many monstrous wells, ready, if a foot should slip, to swallow them up for ever. We stood on the edge to see these people with their lights descend before us; and were amazed and terrified to see them continue descending till they seemed at a monstrous and a most frightful depth. When they were at the bottom, however, they hallowed to us; and we, trembling and quaking, began to descend after them. We had not gone thirty feet down, when we came to a place where the rock was perpendicular; and a vast cavern seemed to open its mouth to swallow us up on one side, while a wall of rugged rock threatened to tear us to pieces on the other. I was quite disheartened at this terrible prospect, and declared I would go back; but our guides assured us there was no danger; and, the rest of the company resolving to see the bottom now they were come so far, I would not leave them: so on we went to a corner where there was placed an old slippery and rotten ladder, which hung down close to the rock; and down this, one after another, we at length all descended. When we had got to the bottom of this we found ourselves at the entrance of another passage, which was terrible enough indeed; but in this there was not wanting something of beauty. This was a wide and gradual descent; at the entrance of which one of our guides seated himself on his breech, and began to slide down, telling us we must do the same. We could discover, by the light of his torch, that this passage was one of the noblest vaults in the world. It is about nine feet high, seven feet wide, and has for its bottom a fine green glossy marble. The walls and arch of the roof of this being as smooth and even in most places as if wrought by art, and made of a fine glistering red-and-white granite, supported here and there with columns of a deep blood-red shining porphyry, made, with the reflection of the lights, an appearance not to be conceived. This passage is at least forty yards long; and of so steep a descent, that one has enough to do, when seated on one's breech, not to descend too quickly. Our guides, that we kept with us, could here keep on each side of us: and, what with the prodigious grandeur and beauty of the place, our easy travelling through it, and the diversion of our now and then running over one another whether we would or not, this was much the pleasantest part of our journey.

journey. When we had entered this passage, I imagined we should at the bottom join the two guides we had first sent down: but alas! when we were got there we found ourselves only at the mouth of another precipice, down which we descended by a second ladder not much better than the former. I could have admired this place also, would my terror have suffered me; but the dread of falling kept all my thoughts employed during my descent. I could not but observe, however, as my companions were coming down after me, that the wall, if I may so call it, which the ladder hung by, was one mass of blood-red marble, covered with white sprigs of rock-crystal as long as my finger, and making, with the glow of the purple from behind, one continued immense sheet of amethysts. From the foot of this ladder we slid on our bellies through another shallow vault of polished green-and-white marble, about twenty feet: and at the bottom of this joined our guides. Here we all got together once again, and drank some rum, to give us courage before we proceeded any farther. After this short refreshment, we proceeded by a strait, but somewhat slanting passage, of a rough, hard, and somewhat coarse stone, full of a thousand strange figures of snakes rolled round, and looking as if alive; but in reality as cold and hard as the rest of the stone, and nothing but some of the stone itself in that shape. We walked pretty easily along this descent for near two hundred yards; where we saw two pillars seemingly made to support the roof from falling in: but in reality it was no such thing; for they were very brittle, and made of a fine glittering yellow marble. When we had passed these about two hundred yards, we found ourselves at the brink of another very terrible precipice: but this our guides assured us was the last; and, there being a very good ladder to go down by, we readily ventured. At the bottom of this steep wall, as I may call it, we found ourselves for some way upon plain even ground; but, after about forty yards walking, were presented by our guides with ropes again; which we fastened about our middles, though not to be swung down by, but only for fear of danger, as there are lakes and deep waters all the way from hence on the left hand. With this caution, however, we entered the last alley: and horrible work it was indeed to get through it. All was perfectly horrid and dismal here. The sides and roof of the passage were all of black stone; and the rocks in our way were in some places so steep, that we were forced to lie all along on our backs, and slide down; and so rough, that they cut our clothes, and bruised us miserably in passing. Over our heads, there were nothing but ragged black rocks, some of them looking as if they were every moment ready to fall in upon us; and, on our left hands, the light of our guides' torches shewed us continually the surfaces of dirty and miserably looking lakes of water. If I heartily repented of my expedition often before, here I assure you I was all in a cold sweat, and fairly gave myself over for lost; heartily cursing all the travellers that had written of this place, that they had described it so as to tempt people to see it, and never told them of the horrors that lay in the way. In the midst of all these reflections, and in the dismallest part of all the cavern, on a sudden we had lost four of our six guides. What was my terror on this sight! The place was a thousand times darker and more terrible for want of their torches; and I expected no other every moment but to follow them into some of these lakes, into which I doubted not but they were

were fallen. The remaining two guides said all they could, indeed, to cheer us up; and told us we should see the other four again soon, and that we were near the end of our journey. I do not know what effect this might have upon the rest of my companions; but I assure you I believed no part of the speech but the last, which I expected every moment to find fulfilled in some pond or precipice. Our passage was by this time become very narrow, and we were obliged to crawl on all-fours over rugged rocks; when in an instant, and in the midst of these melancholy apprehensions, I heard a little hissing noise, and saw myself in utter, and not to be described, darkness. Our guides called indeed cheerfully to us, and told us that they had accidentally dropped their torches into a puddle of water, but we should soon come to the rest of them, and they would light them again; and told us there was no danger, and we had nothing to do but to crawl forward. I cannot say but I was amazed at the courage of these people; who were in a place where, I thought, four of them had already perished, and from whence we could none of us ever escape; and determined to lie down and die where I was. Words cannot describe the horror, or the extreme darkness, of the place. One of our guides, however, perceiving that I did not advance, came up to me, and, clapping his hand firmly over my eyes, dragged me a few paces forward. While I was in this strange condition, expecting every moment death in a thousand shapes, and trembling to think what the guide meant by this rough proceeding, he lifted me at once over a great stone, set me down on my feet, and took his hand from before my eyes. What words can describe at that instant my astonishment and transport! Instead of darkness and despair, all was splendour and magnificence before me: our guides all appeared about us: the place was illuminated by fifty torches, and the guides all welcomed me into the grotto of Antiparos. The four that were first missing, I now found had only given us the slip, to get the torches lighted up before we came; and the other two had put out their lights on purpose, to make us enter out of utter darkness into this pavilion of splendour and glory. I am now come to the proper business of this letter; which was to describe this grotto. But I must confess to you that words cannot do it. The amazing beauties of the place, the eye that sees them only can conceive. The best account I can give you, however, please to accept of.

"The people told us, the depth of this place was four hundred and eighty-five yards: the grotto, in which we now were, is a cavern of one hundred and twenty yards wide, and one hundred and thirteen long, and seems about sixty yards high in most places. These measures differ something from the accounts travellers in general give us; but you may depend upon them as exact, for I took them with my own hand. Imagine then with yourself, an immense arch like this, almost all over lined with fine and bright crystallized white marble, and illuminated with fifty torches; and you will then have some faint idea of the place I had the pleasure to spend three hours in. This, however, is but a faint description of its beauties. The roof, which is a fine vaulted arch, is hung all over with icicles of white shining marble, some of them ten feet long, and as thick as one's middle at the root; and among these there hang a thousand festoons of leaves and flowers, of the same substance; but so very glittering, that there is no bearing to look up at them. The sides of the

the arch are planted with seemingly trees of the same white marble, rising in rows one above another, and often inclosing the points of the icicles. From these trees there are also hung festoons, tied as it were from one to another in vast quantities; and in some places among them there seem rivers of marble winding through them in a thousand meanders. All these things are only made, in a long course of years, from the dropping of water, but really look like trees and brooks turned to marble. The floor we trod upon was rough and uneven, with crystals of all colours growing irregularly out of it, red, blue, green, and some of a pale yellow. These were all shaped like pieces of saltpetre; but so hard, that they cut our shoes; among these, here and there, are placed icicles of the same white shining marble with those above, and seeming to have fallen down from the roof and fixed there; only the big end of these is to the floor. To all these our guides had tied torches, two or three to a pillar, and kept continually beating them to make them burn bright. You may guess what a glare of splendour and beauty must be the effect of this illumination, among such rocks and columns of marble. All round the lower part of the sides of the arch are a thousand white masses of marble, in the shape of oak-trees. Mr. Tournefort compares them to cauliflowers, but I should as soon compare them to toad-stools. In short, they are large enough to inclose, in many places, a piece of ground big enough for a bed-chamber. One of these chambers has a fair white curtain, whiter than satin, of the same marble, stretched all over the front of it. In this we all cut our names and the date of the year, as a great many people have done before us. In a course of years afterwards the stone blisters out like this white marble over the letters. Mr. Tournefort thinks the rock grows like oaks or apple-trees, for this reason; but I remember I saw some of the finest cockle and muscle shells, in the rock thereabouts, that ever I saw in my life. I wonder whether he thinks they grow there too. Besides, if this rock grows so fast, the cavern ought to be all grown up by this time; and yet, according to his measures and mine, the cavern seems on the other hand to be turned larger since. Indeed all that I can gather from his account of this glorious place is, that he had drunk a bottle or two too much before he went down into it."

NATURAL HISTORY OF THE SALAMANDER.

THE salamander has a short cylindrical tail, four toes on the fore-feet, and a naked porous body. This animal has been said, even in the Philosophical Transactions, to live in the fire; but this is found to be a mistake. It is generated in the southern countries of Europe. The following account of this species is extracted from the Count de la Cépède's Natural History of Serpents. - Whilst the hardest bodies cannot resist the violence of fire, the world have endeavoured to make us believe that a small lizard can not only withstand the flames, but even extinguish them. As agreeable fables readily gain belief, every one has been eager to adopt that of a small animal so highly privileged, so superior to the most powerful agent in nature, and which could furnish so many objects of comparison to poetry, so many pretty emblems to love, and so many brilliant

CURIOSITIES AND RARITIES

liant devices to valour. The ancients believed this property of the salamander, wishing that its origin might be as surprising as its power: and, being desirous of realizing the ingenious fictions of the poets, they have pretended that it owes its existence to the purest of elements, which cannot consume it; and they have called it the daughter of fire, giving it however a body of ice. The moderns have followed the ridiculous tales of the ancients; and, as it is difficult to stop when one has passed the bounds of probability, some have gone so far as to think that the most violent fire could be extinguished by the land salamander. Quacks sold this small lizard, affirming, that, when thrown into the greatest conflagration, it would check its progress. It was very necessary that philosophers and naturalists should take the trouble to prove by facts what reason alone might have demonstrated; and it was not till after the light of science was diffused abroad, that the world gave over believing in this wonderful property of the salamander. This lizard, which is found in so many countries of the ancient world, and even in very high latitudes, has been however very little noticed, because it is seldom seen out of its hole, and because for a long time it has inspired much terror. Even Aristotle speaks of it as of an animal with which he was scarcely acquainted.

One of the largest of this species, preserved in the French king's cabinet, is seven inches five lines in length, from the end of the muzzle to the root of the tail, which is three inches eight lines. The skin does not appear to be covered with scales, but it is furnished with a number of excrescences like teats, containing a great many holes, several of which may be very plainly distinguished by the naked eye, and through which a kind of milk oozes, that generally spreads itself in such a manner as to form a transparent coat of varnish above the skin of this oviparous quadruped, naturally dry.

The eyes of the salamander are placed in the upper part of the head, which is a little flattened; their orbit projects into the interior part of the palate, and is there almost surrounded by a row of very small teeth, like those in the jaw-bones: these teeth establish a near relation between lizards and fishes; many species of which have also several teeth placed in the bottom of the mouth. The colour of this lizard is very dark: upon the belly it has a bluish cast, intermixed with pretty large irregular yellow spots, which extend over the whole body, and even to the feet and eye-lids; some of these spots are besprinkled with small black specks; and those which are upon the back often touch without interruption, and form two long yellow bands. The colour must, however, be subject to vary; and it appears that some salamanders are found in the marshy forests of Germany, which are quite black above and yellow below. To this variety we must refer the black salamander, found by Mr. Laurenti in the Alps, which he considered as a distinct species.

The salamander has no ribs; neither have frogs, to which it has a great resemblance in the general form of the anterior part of its body. When touched, it suddenly covers itself with that kind of coat of which we have spoken, and it can only very rapidly change its skin from a state of humidity to a state of dryness. The milk which issues from the small holes in its surface is very acrid; when put upon the tongue, one feels as it were a kind of scar at the part which it touched. This milk, which is considered as an excellent substance

substance for taking off hair, has some resemblance to that which distils from those plants called esula and euphorbium. When the salamander is crushed, or when it is only pressed, it exhales a bad smell, which is peculiar to it.

Salamanders are fond of cold damp places, thick shades, tufted woods, or high mountains, and the banks of streams that run through meadows: they sometimes retire in great numbers to hollow trees, hedges, and below old rotten stumps; and they pass the winter in places of high latitude, in a kind of burrows, where they are found collected, several of them being joined and twisted together. The salamander being destitute of claws, having only four toes on each of the fore feet, and no advantage of conformation making up its deficiencies, its manner of living must, as is indeed the case, be very different from that of other lizards. It walks very slowly; far from being able to climb trees with rapidity, it often appears to drag itself with great difficulty along the surface of the earth. It seldom goes far from the place of shelter it has fixed on; it passes its life under the earth, often at the bottom of old walls during summer; it dreads the heat of the sun, which would dry it; and it is commonly only when rains are about to fall that it comes forth from its secret asylum, as if by a kind of necessity, to bathe itself, and to imbibe an element to which it is analogous. Perhaps it finds then with greatest facility those insects upon which it feeds. It lives upon flies, beetles, snails, and earth-worms; when it reposes, it rolls up its body in several folds like serpents. It can remain some time in the water without danger, and it casts a very thin pellicle of a greenish grey colour. Salamanders have even been kept more than six months in the water of a well without giving them any food; care only was taken to change the water often.

It has been remarked, that, every time a salamander is plunged into the water, it attempts to raise its nostrils above the surface as if to seek for air, which is a new proof of the need that all oviparous quadrupeds have to breathe during the time they are not in a state of torpor. The salamander has apparently no ears, and in this it resembles serpents. It has even been pretended that it does not hear, and on this account it has got the name of *sourd* in some provinces of France. This is very probable, as it has never been heard to utter any cry, and silence in general is coupled with deafness.

Having then perhaps one sense less than other animals, and being deprived of the faculty of communicating its sensations to those of the same species, even by imperfect sounds, it must be reduced to a much inferior degree of instinct: it is therefore very stupid; and not bold, as has been reported: it does not brave danger, as is pretended, but it does not perceive it. Whatever gestures one makes to frighten it, it always advances without turning aside; however, as no animal is deprived of that sentiment necessary for its preservation, it suddenly compresses its skin, as is said, when tormented, and spurts forth upon those who attack it that corrosive milk which is under it. If beat, it begins to raise its tail: afterwards it becomes motionless, as if stunned by a kind of paralytic stroke; for we must not, with some naturalists, ascribe to an animal so devoid of instinct, so much art and cunning as to counterfeit death. In short, it is difficult to kill it; but when dipped in vinegar, or surrounded with salt

reduced to powder, it expires in convulsions, as is the case with several other lizards and worms.

It seems one cannot allow a being a chimerical quality, without refusing it at the same time a real property. The cold salamander has been considered as an animal endued with the miraculous power of resisting, and even of extinguishing, fire; but, at the same time, it has been debased as much as elevated by this singular property. It has been made the most fatal of animals: the ancients, and even Pliny, have devoted it to a kind of anathema, by affirming that its poison is the most dangerous of all. They have written, that, infecting with its poison almost all the vegetables of a large country, it might cause the destruction of whole nations. The moderns also for a long time believed the salamander to be very poisonous; they have said, that its bite is mortal, like that of the viper; they have sought out and prescribed remedies for it; but they have at length had recourse to observations, by which they ought to have begun. The famous Bacon wished naturalists would endeavour to ascertain the truth respecting the poison of the salamander. Gesner proved by experiments that it did not bite, whatever means were used to irritate it; and Wurfbaïnus shewed that it might safely be touched, and that one might without danger drink the water of those wells which it inhabited. M. de Maupertuis studied also the nature of this lizard. In making researches to discover what might be its pretended poison, he demonstrated experimentally, that fire acted upon the salamander in the same manner as upon all other animals. He remarked, that it was scarcely upon the fire, when it appeared to be covered with the drops of its milk, which, rarified by the heat, issued through all the pores of the skin, but in greater quantity from the head and dugs, and that it immediately became hard. It is needless to say, that this milk is not sufficiently abundant to extinguish even the smallest fire. M. de Maupertuis, in the course of his experiments, in vain irritated several salamanders: none of them ever opened their mouths; he was obliged to open them by force. As the teeth of this lizard are but small, it was very difficult to find an animal with a skin sufficiently fine to be penetrated by them: he tried without success to force them into the flesh of a chicken stripped of its feathers; he in vain pressed them against the skin: they were displaced, but they could not enter. He however made a salamander bite the thigh of a chicken, after he had taken off a small part of the skin. He made salamanders newly caught bite also the tongue and lips of a dog, as well as the tongue of a turkey; but none of these animals received the least injury. M. de Maupertuis afterwards made a dog and a turkey swallow salamanders whole, or cut into pieces; and yet neither of them appeared to be sensible of the least uneasiness.—Mr. Laurenti since made experiments with the same view: he forced grey lizards to swallow the milk proceeding from the salamander, and they died very suddenly. The milk, therefore, of the salamander, taken internally, may hurt, and even be fatal to, certain animals, especially those which are small; but it does not appear to be hurtful to large animals.

It was long believed that the salamander was of no sex; and that each individual had the power of engendering its like, as several species of worms. This is not the most absurd fable which has been imagined with respect to the salamander; but, if the manner in which they

they come into the world is not so marvellous as has been written, it is remarkable in this, that it differs from that in which most other lizards are brought forth, as it is analogous to that in which the chalcide and the seps, as well as vipers and several kinds of serpents, are produced. On this account the salamander merits the attention of naturalists much more on account of the false and brilliant reputation which it has so long enjoyed. M. de Maupertuis having opened some salamanders, found eggs in them, and at the same time some young perfectly formed; the eggs were divided into two long bunches like grapes, and the young were enclosed in two transparent bags; they were equally well formed as the old ones, and much more active. The salamander, therefore, brings forth young from an egg hatched within its belly as the viper; and her fecundity is very great: naturalists have long written that she has forty or fifty at one time; and M. de Maupertuis found forty-two young ones in the body of a female salamander, and fifty-four in another.

The young salamanders are generally of a black colour, almost without spots; and this colour they preserve sometimes during their whole lives in certain countries, where they have been taken for a distinct species, as we have said. Mr. Thunberg has given, in the Memoirs of the Academy of Sweden, the description of a lizard, which he calls the Japanese lizard, and which appears not to differ from our salamander but in the arrangement of its colours. This animal is almost black, with several whitish and irregular spots, both on the upper part of the body and below the paws; on the back there is a strip of dirty white, which becomes narrower to the point of the tail. This whitish stripe is interspersed with very small specks which form the distinguishing characteristic of our land salamander. We are of opinion, therefore, that we may consider this Japanese lizard, described by Mr. Thunberg, as a variety of the species of our land salamander, modified a little, perhaps, by the climate of Japan. It is in the largest island of that empire, named Nippon, that this variety is found. It inhabits the mountains there, and rocky places. The Japanese consider it as a powerful stimulant, and a very active remedy; and on this account, in the neighbourhood of Jedo, a number of these Japanese salamanders may be seen dried, hanging from the ceiling of the shops.

CUSTOMS AND MANNERS OF THE INDIANS EASTWARD OF THE MISSISSIPPI.

THERE are twenty-eight different nations of Indians east of the Mississippi; the principal of which are the Cherokees, the Chickasaws, the Choctaws, the Creeks, the Delawares, the Six Nations, the Shawanese, the Hurons, the Illinois, &c. Allowing about seven hundred to a nation or tribe, they will contain, in all, twenty thousand souls, and, consequently, may furnish between four and five thousand warriors.

The Indians are not born white; and take a great deal of pains to darken their complexion by anointing themselves with grease, and lying in the sun. They also paint their faces, breasts, and shoulders, of various colours, but generally red; and their features are well

formed, especially those of the women. They are of a middle stature, their limbs clean and straight, and scarcely any crooked or deformed person is to be found among them. In many parts of their bodies they prick in gunpowder in very pretty figures. They shave or pluck the hair off their heads, except a patch about the crown, which is ornamented with beautiful feathers, beads, wampum, and such-like baubles. Their ears are pared, and stretched in a thong down to their shoulders. They are wound round with wire to expand them, and adorned with silver pendants, rings, and bells, which they likewise wear in their noses. Some of them will have a large feather through the cartilage of the nose; and those who can afford it, wear a collar of wampum, a silver breast-plate, and bracelets, on the arms and wrists. A bit of cloth about the middle, a shirt of the English make, on which they bestow innumerable broaches to adorn it, a sort of cloth boots and mockasons, which are shoes of a make peculiar to the Indians, ornamented with porcupine quills, with a blanket or match-coat thrown over all, completes their dress at home; but, when they go to war, they leave their trinkets behind, and mere necessaries serve them. There is little difference between the dress of the men and women, excepting that a short petticoat, and the hair, which is exceeding black and long, clubbed behind, distinguish some of the latter. Except the head and eye-brows, they pluck the hair with great diligence from all parts of the body, especially the looser part of the sex.

Their warlike arms are, guns, bows and arrows, darts, scalping-knives, and tomahawks. This is one of their most useful pieces of field-furniture, serving all the offices of the hatchet, pipe, and sword. They are exceeding expert in throwing it, and will kill at a considerable distance. The world has no better marksmen, with any weapon. They will kill birds flying, fishes swimming, and wild beasts running.

The Indians are not so ignorant as some suppose them, but are a very understanding people, quick of apprehension, sudden in execution, subtle in business, exquisite in invention, and industrious in action. They are of a very gentle and amiable disposition to those they think their friends, but as implacable in their enmity; their revenge being only completed in the entire destruction of their enemies. They are very hardy, bearing heat, cold, hunger, and thirst, in a surprising manner, and yet no people are more addicted to excess in eating and drinking, when it is conveniently in their power. The follies, nay mischief, they commit when inebriated, are entirely laid to the liquor; and no one will revenge any injury (murder excepted) received from one who is no more himself. Among the Indians all men are equal, personal qualities being most esteemed. No distinction of birth, no rank, renders any man capable of doing prejudice to the rights of private persons; and there is no pre-eminence from merit, which begets pride, and which makes others too sensible of their own inferiority. Though there is perhaps less delicacy of sentiment in the Indians than among us; there is, however, abundantly more probity, with infinitely less ceremony, or equivocal compliments. Their public conferences shew them to be men of genius; and they have, in a high degree, the talent of natural eloquence.

They live dispersed in small villages, either in the woods, or on the banks of rivers, where they have little plantations of Indian corn, and

and roots not enough to supply their families half the year, and subsisting the remainder of it by hunting, fishing, and fowling, and the fruits of the earth, which grow spontaneously in great plenty.

Their huts are generally built of small logs, and covered with bark, each one having a chimney, and a door, on which they place a padlock.

Some huts are built by setting up a frame on forks, and placing bark against it; others of reeds, and surrounded with clay. The fire is in the middle of the wigwam, and the smoke passes through a little hole. They join reeds together by cords run through them, which serve them for tables and beds. They mostly lie upon skins of wild beasts, and sit on the ground. They have brass kettles and pots to boil their food; gourds or calabashes cut asunder serve them for pails, cups, and dishes.

The accounts of travellers concerning their religion, are various. All agree that they acknowledge one Supreme God; but do not adore him. They have not seen him, they do not know him, believing him to be too far exalted above them, and too happy in himself, to be concerned about the trifling affairs of poor mortals. They seem also to believe in a future state, and that after death they shall be removed to their friends, who are gone before them, to an elysium, or paradise.

They have their festivals, and other rejoicing days, on which they sing and dance in a ring, taking hands, having so painted and disguised themselves that it is difficult to know any of them; and, after enjoying this diversion for a while, they retire to the place where they have prepared a feast of fish, flesh, fowls, and fruits; to which all are invited, and entertained with their country songs. They believe that there is great virtue in feasts for the sick. For this purpose a young buck must be killed, and boiled, the friends and near neighbours of the patient invited, and having first thrown tobacco on the fire, and covered it up close, they all sit down in a ring, and raise a lamentable cry. They then uncover the fire, and kindle it up; and the head of the buck is first sent about, every one taking a bit, and giving a loud croak, in imitation of crows. They afterward proceed to eat all the buck, making a most harmonious melancholy song; in which strain their music is particularly excellent.

As they approach their towns, when some of their people are lost in war, they make great lamentations for their dead, and bear them long after in remembrance.

Some nations abhor adultery, do not approve of a plurality of wives, and are not guilty of theft; but there are other tribes not so scrupulous in these matters. Among the Chickasaws a husband may cut off the nose of his wife, if guilty of adultery; but men are allowed greater liberty. This nation despises a thief. Among the Cherokees they cut off the nose and ears of an adultress; afterward her husband gives her a discharge; and from this time she is not permitted to refuse any one who presents himself. Fornication is unnoticed; for they allow persons in a single state unbounded freedom.

Their form of marriage is short.—The man, before witnesses, gives the bride a deer's foot, and she, in return, presents him with an ear of corn, as emblems of their several duties.

The

The women are very slaves to the men ; which is a common case, in rude unpolished nations, throughout the world. They are charged with being revengeful : but this revenge is only doing themselves justice on those who injure them, and is seldom executed but in cases of murder and adultery.

Their king has no power to put any one to death by his own authority ; but the murderer is generally delivered up to the friends of the deceased, to do as they please. When one kills another, his friend kills him, and so they continue until much blood is shed ; and at last the quarrel is ended by mutual presents. Their kings are hereditary, but their authority extremely limited. No people are a more striking evidence of the miseries of mankind in the want of government than they. Every chief, when offended, breaks off with a party, settles at some distance, and then commences hostilities against his own people. They are generally at war with each other. These are common circumstances among the Indians.

When they take captives in war, they are exceedingly cruel, treating the unhappy prisoners in such a manner, that death would be preferable to life. They afterwards give them plenty of food, load them with burdens, and when they arrive at their towns they must run the gauntlet. In this, the savages exercise so much cruelty, that one would think it impossible they should survive their sufferings. Many are killed ; but, if one outlives this trial, he is adopted in a family as a son, and treated with paternal kindness ; and, if he avoids their suspicions of going away, is allowed the same privileges as their own people.

THE INSTRUCTIVE NATURALIST, No. I.

OF THE PROPERTIES OF ANIMAL LIFE.

NO minerals, whatever be their forms or the regularity and beauty of their figures, were ever said to possess any thing like organs of nutrition ; and, however frequently some may recover their lost shapes, they are never supposed either to produce, or assist in producing, their own kind by generative powers. And no plants, however much may be said of animals that want a nervous system and a heart, and are fixed, without the power of locomotion, to one place ; we say no plants, though some may represent a few of the simpler effects of sensation, and others may be free to float through the ocean, were ever said to discover any signs of voracity, to possess any thing like a stomach, to distend their body by swallowing their food, to apply their food to the mouths of absorbents opening internally, and, when the nutritious juices were extracted, to eject it *in cumulo*. It has been said that zoophytes present similar phenomena. But what are zoophytes ? One half of their name would imply that they are animals, another half would insinuate that they are plants. D'Aubenton reasons with clearness on this subject. True, says he, the greatest part of them are branched like plants, and like plants are composed of concentric circles. Some have a soft exterior substance which is called bark, and a hard interior which is called wood. Along their branches, and at their extremities, they put forth vesicles which resemble buds ; and, when a part falls from the whole, it is sufficient,

sufficient, like a vegetable slip, to produce a zoophyte : but do these appearances prove that they are plants ?

If ramifications constitute a plant, then many crystallizations will be plants ; the shootings of frost on our windows will be plants ; the silver tree of Diana a plant ; our veins will be plants ; our arteries plants ; and our very feet which ramify into toes, and our hands into fingers, will have some title to be called plants. The truth is, ramification is not universal in the vegetable kingdom ; and, although it be general, it is no more peculiar to plants, than swimming is to fishes or flying to birds. If concentric circles constitute a plant, some bones of animals will then be plants, and some minerals must also be plants. The wood and the bark are only two metaphorical expressions, which with equal propriety might have been used of the bone and periosteum. But once suppose the zoophyte a plant, it was natural to carry on the analogy, and certainly necessary to have it provided with wood and bark ; though it must be allowed that a corneous substance is not what we commonly mean by bark, nor an evidently hard calcareous substance what we mean by wood. The small vesicles, except in appearance, have no similarity to buds or fruits : they are the residences of small polypes, to whom the whole structure has been owing, by whom the whole either is now or has been inhabited, and to whom it answers the same purpose as the shell does to testaceous animals.

After thus endeavouring to point out the boundaries between the mineral, the plant, and the animal, before we begin to treat of the functions, we must also take notice of another distinction ; the want of which has occasioned much unnecessary trouble, and has given rise to not a few ridiculous disputes. This is the distinction between living bodies and some ingenious contrivances of art, which are called machines. It has not been asserted that any machine can either grow or propagate its kind ; that it can assimilate the particles of matter that come in contact ; that it is able to repair the injuries which it may suffer ; that it can accommodate itself to circumstances, can create heat when the cold is keen, or cold when the heat becomes too violent : yet it has been supposed, from established prejudices, and from the successive evolution of parts in plants and in animals, that there is an analogy between a machine and a living body. The living body has been called a machine ; and notwithstanding the acknowledged truth of that observation so often repeated since the days of Hippocrates, That the whole is a circle, that nothing is first and nothing last in the animal economy, we are still talking as if living bodies were nought but machines ; we are still reasoning as if their parts had existed in succession, had acted in succession, were combined in succession ; we are still seeking for what is prior and what is posterior, for what is derived and what is original in point of structure, as if we were examining a work of art ; we speak gravely of the viscera, of the thorax deriving a coat from the membranous pleura, the abdominal viscera from the peritoneum, and the branches of nerves deriving a pair from the dura and pia mater of the head ; we argue with people who maintain that fasciæ are nervous expansions, and the muscles themselves but nervous productions : and although we be hardly able to conceive how the brain could be nourished without blood thrown from the heart, or the heart move without the assistance of nerves from the brain, we

are still disputing about which was prior and which was posterior in point of existence; a dispute that will probably terminate as soon as that of the ancients, whether the first eggs were from birds, or the first birds were hatched out of eggs.

These dark and inscrutable mysteries of nature we presume not to explain: they point out almost the creative hand, and bring us almost into the immediate presence of that Being by whom we live, move, and exist; and before whom the truly feeling and elevated mind is less disposed to examine than adore. We are only to observe, that from this coeval formation of parts which the microscopic part of anatomy has often distinguished from their evolutions, and from this mutual dependance of organs one on another, we are left at freedom to begin at any part of the circle, and treat of the general properties and functions of living bodies.

Attending minutely to a living body, which already has escaped from the seed, the egg, or membranes of the parent, which is wholly disengaged from the placenta, and depends for the future on the operation of its own organs, we may observe, that in order to live, it must be allowed the free use of air as applied by the organs of—*Respiration*.

That, in order to grow, it must have likewise a supply of food, which is a substance somehow adapted to its constitution; and which, on being received into the system, is prepared by *Digestion*—taken up by *Absorption*—distributed by *Circulation*—assimilated by *Nutrition*—and the whole carried on by means of *Secretion*.

We may next observe, that in order to enjoy the free exercise of these functions, it must be secured from the more common and external injuries of its situation; and that this is done by certain integuments originally produced, and, when it is necessary, afterwards renewed by that function: which we shall venture to call *Integumentation*.

We again may perceive, that these functions are all dependant on a general principle, *Irritability*—by which the system is rendered by stimulants susceptible of *Motion*—accommodates itself to different circumstances by means of *Habit*—alters its shape by successive *Transformation*—produces the species by *Generation*—and, when the business of life is finished, is, after many a languid affection from the influence of *Sleep*—at last subjected to the general fate of all living bodies, *Death*.—These are the general properties of living bodies; and such is the order in which we are now to take a short and cursory view of them.

RESPIRATION is that function by which air is brought into the system, and by which it is prepared in particular organs, that in some respect succeed the placenta in the general economy. For, as any interruption of the usual intercourse between the placenta and fœtus in ovo proves soon fatal, so when that communication naturally ceases, and the new one succeeds between the lungs and external air, it is likewise found, that any preternatural interruption of this last is in all living bodies presently attended with various symptoms of increasing languor, and in many with an almost instantaneous death.

So essential is respiration to the system, that snails, caméléons, and some other animals, can live for years upon air alone. We have seen a caméléon that lived and was vigorous for twenty-two months without any food, and which might have continued to live much longer but for an unfortunate bruise by a fall.

Other

Other phenomena equally demonstrate the importance of air to the living body. The frog leaps away wanting its heart; it survives the loss of greatest part of its spinal marrow. Without its head, it lives for some days, and its heart continues to circulate its blood. Spallanzani took one from the back of a female, cut off his head, and after performing this whimsical experiment, saw the gallant return to his mistress, grasp her in his arms, and finish the task which he had begun. "Two days (says Dr. Monro) after cutting off the head of a frog at its joining with the first vertebra, I found it sitting with its legs drawn up in their usual posture; and, when its toes were hurt, it jumped with very considerable force. Its heart likewise continued to beat, about forty times in a minute, and so strongly as to empty itself and circulate the blood. In several frogs, after cutting off the back part of the six undermost true vertebrae, I took out all that part of the spinal marrow with the cauda equina which they cover. The lower extremities were rendered insensible to common injuries, and lay motionless: yet the frogs lived several months after, and the wounded parts of their backs cicatrised, and the bones of their legs which I fractured were united, the blood circulated freely in their vessels." Borelli also found, that eels and serpents, though their bodies be opened, and the whole of their viscera be taken out, are able to move for a day after; and yet notwithstanding, in all these animals, the life is observed to be suddenly extinguished when the all-vivifying air is excluded. Even the smallest insect has died, and the plant lost its vegetative power, when retained for any while in a vacuum. The fish itself, when placed under the exhausted receiver, has started anxiously to the surface of the water in quest of fresh air; and, finding none, has sunk to the bottom and expired in convulsions.

If objections should be made to these trials performed in a vacuum; if it should be said that under the receiver the shrivelled fruit swells and turns plump, that the body of the frog is strangely inflated, that its turgid eyes grow prominent in its head, and that thin phials corked full of air are broke by its expansion; still there are facts which do not admit of the like equivocal interpretation. All living bodies will die in the air which they have respired; and when ice covers the whole of the water, many of the fishes are known to perish; or, if an opening be made in the ice, to hasten to the air, and, rather than retire, quietly suffer themselves to be caught.

To this general dependance of life upon respiration, there occur but few things like an exception: these are some serpents and worms and crustaceous animals found alive in the hearts of stones, some insects that were found in wood, and a number of toads which in different places have been taken from the hearts of trees and of rocks where they left an impression, and where they were supposed in some cases to have lived for centuries without air. These facts, real or pretended, have been the cause of much speculation. Some philosophers, who imagine that nature is always obliged to act agreeably to those ideas which they have already formed of her laws, are, notwithstanding the high authorities by which some of these facts are attested, disposed to doubt them. General analogy, which regularly opposes singular phenomena, is upon their side; and, without her concurrence, they will grant existence to no living body that will not submit to the old established modes of respiration. Others again, who would not presume to dictate for nature, who have long experienced

rienced that she is not forward to obtrude her secrets, and who can believe that she may have still some to communicate, consider these facts as something new which she meant to impart; and as one of the instances where she seems to deviate from general analogy in adhering to her grand accommodating principle by which she fits every living body for a certain range of varying circumstances.

As we know not how far the great accommodating principle of nature may be extended, perhaps the absorbents opening externally may in these animals sometimes supply the place of the lungs, as the lungs supplied the place of the gills which they used when tadpoles, and as the gills had formerly supplied the place of a placenta, or the primary absorbents, through which they derived their nourishment in ovo.

Those stones which inclose animals are known to be such as have gradually assumed the solid form, and those animals which have been inclosed are known to be such as in other cases have been subjected to the torpid state: but this state has not been examined with all the attention which it deserves. From this state, Bonnaterre says, in his Introduction to Ereptology, that it is impossible to rouse the animal by the loudest noise, the rudest shock, or the deepest wound; the internal motion is just sufficient to preserve the system from that decomposition to which animal substances are exposed. It retains only the form of what it was. It appears neither to live nor to grow; and the whole mass, if what is exposed to the air be excepted, is not sensibly altered while the torpor continues. All the senses are shut up; all their functions are entirely suspended: digestion is no longer in the stomach; all respiration has apparently ceased; and it has been doubted whether or not this function be in some cases at all retained. When the genial warmth, however, returns, in six, in eight, or in ten, months, according to that variety of climates between the frigid poles and the tropics, the animal revives. But the question is, if the first circumstances in which the animal became torpid had been artificially or naturally continued, how long in this way might the different functions of life have been suspended; and how far are we warranted by the analogy of seeds and of eggs to lengthen this period of their existence, without supposing a decomposition or destruction of organs?

Experiments must tell what are the limits which nature has here prescribed to herself. New eggs, when covered with varnish, or placed under the exhausted receiver, are secured against the attacks of corruption. Bomare, in his dictionary, has mentioned three, which, protected from air, were found fresh in the wall of a church after a period of three hundred years. And if it be true that a snake found in a block of marble died as soon as exposed to the air, or if the parts in contact with air be the only ones which in torpid animals appear to be changed, it would seem probable that a total exclusion of this varying and active element would tend more to the preservation of torpid animals, in certain instances, than a free admission, which, in those cases where all vital functions have ceased, is regularly found a principal agent in their dissolution.

M. Herissant of the French Academy was the first philosopher who, by means of experiment, thought of interrogating nature herself upon this subject. On the 21st of February 1771, he with great accuracy shut up three toads from the air, two of which were
taken

taken out alive on the 8th of April 1774. D'Aubenton says, after a period of eighteen months; but in this instance we depend more on the friend of Fontana, who has mentioned the dates. The two toads were again inclosed, and Herissant died before there was a second inspection. D'Aubenton says, that when taken out their bodies were hard and shrivelled, and their whole moisture totally absorbed. A fourth toad that had been inclosed was heard to croak whenever the box in which it was confined happened to be shaken. The practice is common of confining snails in a sealed phial, where they exist in torpor for years. These phenomena still excite wonder, but to wonder less, and examine more, would sooner procure us that information which we are wanting. In these observations concerning toads, have no circumstances been overlooked? Has it been determined whether they lived in the heart of stones, or, existing merely in a torpid state, had come alive when exposed to air? We have seen a toad that was dead for two days; its body was opened; its heart was seen motionless, but exposed to air in a few seconds it began to beat.—Considering the complex functions of absorbents, we may easily conceive how a toad could live in the clefts of rocks, or the hearts of trees, where there is moisture.

In all living bodies there appear to be certain degrees of heat, peculiarly fitted for carrying on their various economical operations. What these are, in the different kinds of plants and animals, is not known. It would seem that respiration, besides imparting aerial food, was intended to preserve and regulate these different degrees of heat. It raises the heat after a meal; it suffers it to fall in the time of sleep; it withdraws the supply when the atmosphere is warm, and increases it again when the atmosphere is cold. It should therefore be remembered, that heat merely is not the object which is solely aimed at in respiration. All living bodies have their congenial degrees of heat. The regulations of these is important; on the one side, it prevents the dissipation, on the other the coagulation, of their fluids, it preserves the living power of their organs; and, by a natural and proper temperature, assists their action in mixing, composing, in decomposing, and in variously preparing the different parts for secretion, excretion, absorption, re-absorption, and assimilation.

As various fixations of the vascular fluid are regularly taking place in the different parts of the living body, and as air is not the only fluid concerned, it should almost be unnecessary again to observe, that the whole of the heat is not evolved in the lungs, nor the whole that is evolved disengaged from air.

It may farther be remarked, that the whole of the air does not enter by the lungs; much is contained in the liquid and solid parts of the food. It is extricated often in the process of digestion; and, when the organs are vigorous and healthy, is made subservient to the general economy. If the organs, however, should happen to be languid, it scorns their authority, which cannot be enforced; from being friendly, it soon becomes inimical to the system, and threatening danger accumulates, not only in the stomach and intestines, but in other cavities. It has been found in the cellular membrane; in certain vesicles formed for itself; in the uterus; in an abscess; and in gun-shot wounds: it has sometimes burst from the vagina with a sort of noise. And in a nephritic complaint of a horse, we have ob-

served it flowing in a stream from what the farriers denominate the *sheath*.

In some kinds of aquatic plants, in eggs, and in a variety of fishes, there are certain vesicles containing air, which seem to have certain necessary functions allotted them by nature. In the plants and in fishes they were once supposed to have been wholly intended for swimming. It is remarked, that those fishes which remain constantly at the bottom of the water have no air vesicle; and that a fish whose vesicle was burst by means of the torricellian vacuum, though it lived for a whole month after in a pond, was never able to rise to the surface. The practice, however, which some fishes have of ascending at times to inhale air, and descending after their vesicle is filled; the communication which, in some fishes, this air vesicle has with the stomach; that power in the pigeon and some other birds of introducing air into the crop; and lastly, the air which is uniformly found in impregnated eggs—would tempt us to believe that these natural collections of air, with their other uses, may perform some essential service in nutrition.

Having explained the general intension of respiration, we are now to inquire, what are the kinds of respiratory organs, and in what manner their functions are performed? Some animals breathe by a tracheæ and lungs; insects, by either stigmata or tracheæ, opening into air vessels; plants, by air vessels and leaves; fishes, and numbers of the watery element, if they do not breathe, at least receive air by their gills; their foetus in ovo, the polypus tribe, and many more organized bodies, by the same organs which convey their food.

The absorbents appear to be the first and most general way by which living bodies are supplied with air: the mouths of these vessels are like tubercles scattered over the body of the insect while wrapt in its membrane. In the horse and the bird they are blood-vessels spreading on a membrane, and deriving nourishment from the uterus or egg, that had been itself nourished by absorbents: in a cow, they are vessels which, spreading on a membrane, terminate in glands; these glands being opposite to others which adhere to the uterus; and the membranous and uterine glands, when in contact, inclosing a third gland like a kernel. In man, they are vessels spreading on a membrane, and entering a large glandular body called the *placenta*. In the mouse and the hare, they are likewise vessels branching on a membrane, and entering a *placenta*: this *placenta*, when it happens to be fixed, receives large veins from the parent, and which may be either inflated or injected from the cavity of the uterus.

Those which are properly respiratory organs, exercise not their function till circulation and nutrition are begun: though, if the observation of Garman be just, that the air might become a real food for the class of spiders, or if it be true that the larvæ of ants as well as of several insects of prey, increase in bulk, and undergo their metamorphoses, without any other nourishment than air, this law is not universal. It may, however, be doubted, whether some moisture may not be absorbed. With regard to the ant, we have reason to suspect that the observations on which such a conclusion was founded have not been accurate.

Not only are the respiratory organs thus late in exercising their functions; in many vegetables a great part of them is annually renewed

newed and laid aside in the torpid state. In those insects which undergo the most remarkable kinds of transformation they suffer a change; and in all those animals which spend their earlier days in the water, and afterwards come to live in the air, they are altered in kind.

In all living bodies the proper function of one part of the respiratory organs is, to secrete from the water or air that particular aeriform fluid which mingles with their juices, and which is necessary to life and nutrition. In many cases these organs are placed externally, and are always in contact with the air or water from which they secrete. In other cases they are lodged internally; and air or water are then alternately admitted and expelled by varieties of organs which serve as auxiliaries.

The plants secrete their aeriform fluid from water and air. They receive air along with the liquids of their absorbents, which open on the roots, the trunk, and the branches, and upon the inferior surfaces of leaves; or, if nature has plunged these leaves under water, the absorbents open and imbibe their fluids on both sides. In many, however, the upper surface of the leaf is intended to inhale air. Bonnet observed, that, when this surface was applied to the water, the leaf died soon; but that, when the lower surface was applied, it lived for months. It has also been remarked, that the upper surfaces of some leaves will repel water; and that the death of the leaf will ensue when its breathing pores are obstructed with oil. We hence learn why aquatic plants rise up to the surface of the water and spread their leaves in the open air; and as it is proved by Ingenhousz and others, that the respiration of many leaves is assisted by light, we see a reason why plants growing in a dark room turn to the place where light is admitted; why the flowers and the leaves of many plants follow the diurnal course of the sun; why the branches of trees, which require much light, die when placed in a thick shade; why moonshine in autumn contributes so much to the ripening of grain; and why leaves and branches are arranged in such a manner as least to intercept that quantity of light which nature has allotted to the genius of each.

The air vessels in the body of plants are those vessels which contain juices but at certain times, and which during the greatest part of the season are filled with air. This air is collected from the sap of the roots as it passes along the diametral insertions, and from those vessels which open upon the trunk and upon the leaves. Like pulmonary tubes, which are seen branching through the bodies of insects, they perform an office similar to that of the tracheæ and bronchia; and are those general receptacles of air from which the neighbouring parts of the plant secrete what is needed: for, in plants and a certain number of insects, the functions of the lungs, the stomach, and the heart, are generally diffused. The several parts can respire, digest, and circulate fluids on their own account; and, if they should chance to be severed from the whole, can live and grow, and propagate their kind.

The air vessels are surrounded by those which contain a liquid during the whole time of the growth. They are the largest vessels of the wood, as distinguished from the bark; and in the leaves they may sometimes be seen even without the assistance of glasses. Their cavity is formed by certain fibres which wind spirally like a corkscrew.

screw. In the leaf they generally approach and recede like the filaments of nerves; but they never inosculate from one end of the plant to the other; except at the extremities; they resemble the pulmonary tubes of insects by their general dispersion over the system, and the spiral rings of which they are composed; they differ in this, that the pulmonary tubes are frequently observed to anastomose in their larger branches, as the ramifications of a vein or artery do in their smaller capillary twigs.

The respiratory organs, which are similar either to the gills of fishes or the lungs of man, can hardly here claim a description, as their nature and forms are so generally known. There is one circumstance, however, in birds which arrests our attention: the cells of their bones, and the numerous vesicles of their soft parts which communicate with the lungs, have been deservedly a matter of surprise to most naturalists. In accounting for their use, the ingenious Hunter supposed that they lessened the specific gravity and assisted flying; that being the circumstance which he thought most peculiar to birds. Learning afterwards that they were in the ostrich and not in the bat, he supposed that they were appendages to the lungs. In amphibious animals, in the snake, viper, and many others, he observed, that "the lungs are continued down through the whole belly in form of two bags, of which the upper part only can perform the office of respiration with any degree of effect, the lower having comparatively but few air vessels." In these animals, the use of such a conformation of the lungs was to him evident. "It is in consequence of this structure," said he, "that they require to breathe less frequently than others." From this reasoning he naturally inferred, that the motion of flying might render the frequency of respiration inconvenient; and that a reservoir for air might therefore become singularly useful. The bat and the ostrich, however, are here as formidable objections as before. The bird respire frequently when at rest, and when it flies to our bosom from the hawk; that frequency seems to have been increased by what is a general and a common cause, an increased degree of muscular exertion. Had air cells been intended merely to prevent the effects of a rapid motion on respiration, we might expect to see them in greyhounds and a number of quadrupeds, much more readily than in some birds whose flights are neither rapid nor long.

This great physiologist was not aware that the circumstance most peculiar to birds was not their act of flying, but their feathers, which contain a large quantity of air, and which require a regular supply, whether they soar on the wings of the eagle, or remain on the ground attending the ostrich.

Both in amphibious animals and birds, the air of the vesicles has passed the respiratory surface of the lungs. In the tracheæ of plants and the pulmonary tubes and vessels of insects, it is only proceeding on its way to be respired. From the general diffusion of air through the birds, and the situation of their vesicles beyond the lungs, it would appear that the pulmonary viscus in these animals does not respire or secrete air for the whole system; and we are certain that in plants and insects most parts respire the air for themselves, and that there is no particular part appointed to secrete air for the whole.

We here speak of the respiratory organs as those which secrete an æriform fluid from water and air; but our language probably had been

been more accurate had we called them the organs in which an aeriform fluid is absorbed by their liquid contents, as these flow by, either wholly or in part, in their course through the system. It was long denied that any absorption of the air took place from the pulmonary surface; and speculative reasoners had attempted to prove that no air could pass to the blood through the membranes of the lungs, because air had refused upon some occasions to pass through pieces of wet leather that had been exposed to it for that purpose. Borelli, however, endeavoured to shew how air in the lungs might mingle with the blood, and how some always disappeared in respiration. There are few doubts now entertained on this subject. Venous blood inclosed in a bladder by the celebrated Priesley discovered such an attraction for oxygene, that it absorbed the aeriform fluid through all the coats of the resisting medium, exhibiting an instance and beautiful illustration of the chemical affinities which take place in this function.

The reader will observe, that the two words *respiratory organs* are here employed in what may be rather a particular sense. The truth is, there are two kinds of respiratory organs, which, though sometimes included in the general expression, should always be considered as perfectly distinct. The first kind comprehends those in which the water and air is decomposed; the second, those by which these fluids are properly applied to the respiring surface of the former. We observe these last in the fluttering motion of the leaf itself, or in that tendril which turns the surface of the leaf to the sun. We see them producing these oscillatory motions in the branching gills of the *pulex arborescens*. When the breathing surface is within the body, we discover them again in the tracheæ of plants, whose cavity is formed by a spiral fibre that is seemingly intended for some kind of peristaltic motion. We detect them likewise in the pulmonary tubes, in the spiral rings, and in the abdominal movements of insects. We see them in fishes swallowing the water and propelling it onward through the fringes of the gills. In the frog, we note them by the motions of the pouch between the sternum and the lower jaw. After this animal is divided transversely behind the fore legs, this pouch continues to fill and to empty itself downwards by the tracheæ where the lungs were. When the whole integuments and some of the muscles between the jaw-bone and sternum are removed, we see how the pouch was dilated and contracted by a broad cartilage connected with the tracheæ, and attached by muscles to the inside of the sternum and the neighbouring parts. When the pouch is enlarged, the air rushes in through the two nostrils at that time expanded; and when it is contracting, the glottis starts up with an open mouth to the middle of the pouch, and the air is pressed down through the tracheæ to the lungs. This amusing sight will sometimes continue for a whole hour. In man and all the warm-blooded quadrupeds, the thorax or cavity where the lungs are placed is dilated and contracted by the diaphragm and muscles attached to the ribs. In the time of dilatation the glottis opens, as we see in birds: the air rushes in, supports the incumbent weight of the atmosphere, and enables the thorax to expand wider. The expanding powers having made at last their usual effort, their antagonists succeed, exert their force, and their air is expelled.

In

In applying either the water or air to the breathing surface, all these auxiliary organs are assisted by the circumambient fluid which presses equally on all sides. When a Florentine flask is applied to the mouth, and all communication between the larynx and external air entirely cut off, it requires an effort to bring the air of the flask into the lungs; the weight of the atmosphere is therefore assisting in respiration; and the air, whether in the lungs or the thorax (supposing that there be any in the thorax), must not be so dense as that which is without. When Verheyen perforated the thorax of a dog, and restored the equilibrium betwixt the external and internal air, the respiration of the lungs ceased, though for some time the alternate admission and expulsion of air was continued through canulas introduced into the wounds.

It cannot surely be asked here, how the pressure of the atmosphere should be assisting in raising the thorax, and thus seemingly counteract itself? The heat of the lungs expands the air as soon as it enters. The air rapidly absorbs moisture; and, though not usually noticed by philosophers, yet the sudden expansion, which is always the consequence of that absorption, is a very general phenomenon in nature. By this heat, or by this absorption, the air would occasion greater dilatation, were it not for the lungs, which seek to collapse; the cartilages of the sternum, which seek to recoil; and the stretched-out muscles, which either spontaneously, or directed by the will, endeavour to contract and produce expiration.

Having seen how the air will rush in on the opening of the glottis, we may also conceive how the shutting of the glottis will resist the force of internal expansion, and support a weight laid upon the breast. The confined air will expand equally on all sides, and the pressure must be great before the space which falls to the glottis can exceed its own muscular force and the weight of the atmosphere. It is this diffused pressure of fluids that produces such striking wonders in hydraulics; and which explains how the droppings of the ureters should expand the bladder even to a palsy, and overcome the abdominal muscles.

To account for the action of these organs which serve as auxiliaries in respiration, there have been supposed an appetite for air which prompts as a stimulus; an influence of the will, though we breathe while asleep; and a natural instinct, which indeed may exist, but explains nothing. In specifying the several organs concerned, we have heard of an expansile power of the lungs, of a certain pressure of the phrenic nerve, of a muscular diaphragm, and of the action of oblique intercostals. But these explanations are from a limited view of the subject. The expressions used may indeed be general; but their meaning is particular, narrow, and confined; and their allusion is only to man, or perhaps to a few of the warm-blooded quadrupeds: for where are the intercostals of the frog? where is the muscular diaphragm of birds; where the pressure of their phrenic nerve? and where the expansile power of their lungs?

It is fortunate for man that these assisting respiratory organs are in some measure subject to his will. By this subjection he produces vocal sound when he pleases, divides it into parts, varies it by tones, forms it into words, and enjoys the distinguished and numerous advantages that may be derived from a spoken language.

CONNEXION

CONNECTION BETWEEN AGRICULTURE AND COMMERCE.

THE Netherlands in general, and the province of Flanders in particular, though now cultivated and improved to the utmost, afforded at one period a very different prospect. The vast forest of Ardennes, of which some small but ornamental remains still continue, overspread and rendered useless almost its whole extent. The Counts of Flanders were, on this account, stiled the Foresters of Flanders. The country was, besides, covered with marshes and stagnant waters. The Scheldt, unrestrained by the hand of man, overflowed its level banks, deluged the neighbouring plains, and rendered them at once both desolate and unhealthy. Agriculture has effected the wonderful change now observable: introduced first by the monks, and adopted afterwards by the peasants, it made rapid advances to perfection, in proportion as the latter were relieved from the feudal oppression, and secured from the rapacity of their lords. The manufactures afterwards established in the cities of Flanders afforded additional encouragement to the cultivation of the country. They doubly promoted its progress to perfection: the husbandman, secure of a ready market for his productions, in the rising consumption of the crowded towns, was invited to increase his exertions; and, by augmenting his capital, was enabled more effectually to execute the necessary improvements in his farm. The adventurous merchant, not finding sufficient scope for the employment of his wealth in commerce, or allured by the natural attractions of the country, exerted the same spirit in cultivation he did in trade, and, by securing his riches in the soil, rendered their benefits permanent to future generations. The princes of Flanders afforded peculiar encouragement to these exertions, and judiciously bestowed premiums on those who excelled in the most useful of all occupations. The effects of so fortunate a combination of circumstances soon became visible. As early as the twelfth century, the forests of Flanders were extirpated; canals were formed, which at once drained the country, and opened a communication between its most distant districts. The Scheldt, restrained to its proper bed by the necessary precautions, no longer desolated the country it should enrich; the soil was laid open to the beneficial influence of the atmosphere; and Flanders became the most fertile and cultivated portion of Europe.

A variety of well-known causes, not here necessary to be enumerated, have deprived those countries of the commerce which they once possessed; their agriculture, however, feels no decay, and still affords employment to the numerous inhabitants. The manufactures of Louvain have disappeared; the trade of Antwerp is extinct; and many of its other cities have been depopulated; but the fields of Flanders retain their fertility; their population is augmented almost beyond parallel, and they afford an irrefragable proof, that agriculture is the most solid basis of national prosperity.

Even the ravages of war are not able to deprive agriculture of the possession of the soil which it once obtains. In the sixteenth century, a period the most unprosperous to these provinces, when all their other arts declined or disappeared, the cultivation of the earth retained its native vigour: during the almost continued tranquillity of the present, it has progressively advanced to still higher improve-

ment. Their husbandry (if not injured by late commotions) is now unequalled in any part of Europe; their population surpassed by none; their inhabitants feel no want of employment; and their comfortable habitations, wholesome food, and the decent competence they enjoy, express, in strongest terms, to the delighted traveller, that each shares the plenty which pervades his fields.

The present state of Lombardy and Tuscany would lead us to similar conclusions. Though the misfortunes of Italy, in the fifteenth and sixteenth century, considerably injured the commerce and manufactures of their cities, the surrounding country is still one of the most cultivated and populous in Europe.

One of the most prevailing and powerful causes of the backward state of Irish agriculture is, the want of capital among the immediate cultivators of the soil. This want of capital is obviously evident from their wretched appearance, and miserable modes of life. Behold the Irish husbandman sally forth to his work, barefoot and covered with rags; behold his ruinous hovel, built of mud, covered with weeds, and pervious to every shower that falls, and every pinching gale that blows. Behold him seated, after a hard day's labour, by a fire, gleaned, perhaps, from the furze brake that overspreads his lands, involved in smoke, surrounded by a naked offspring, and sharing among them his dry and scanty meal. Look at his farm; a car thrown across a gap protects, in place of gates, the superior verdure of some reserved pasture; at which his lean horse, if such he possess, or starving cow, casts a hungry and desponding eye—his miserable crops are over-run with weeds; his temporary fences tumbling to decay; and every surrounding object, in short, affords convincing testimony of his extreme poverty. The want of capital among the Irish occupiers of land is equally evinced from considering the different motives to labour, by which they, and the more opulent farmers of other countries, are actuated. The Irish husbandman cultivates the earth merely to support existence. As he expends no capital, he looks not to a return of profit. He expects no recompence for a life of labour, but the means of its prolongation. The English, or other opulent farmer, expects from his profession, not merely the recompence of his own labour, or the means of sustaining life, but the accumulation of profit proportionate to the amount of capital which he expends in its prosecution.

Agriculture, as well as every other branch of business, requires, to be carried to any degree of perfection, a fund or capital, which is at first expended in a variety of preliminary operations, without any immediate advantage, but which ultimately returns with accumulated profit. In England, no man thinks of taking a farm without a certain proportion of capital, and a stock of farming utensils. In Ireland, the wretched peasant will undertake the management of many acres without sixpence in his pocket, and no means of breaking and improving the stubborn glebe but the spade he carries on his shoulder. To remedy, as much as possible, these inconveniences, he associates with others in a similar situation. Thus endeavouring to supply the place of capital, and the various necessary apparatus of agriculture, by an union of the powers of that rude labour, which, divided, must be still more inadequate to the task it attempts to effect.—Hence arises the destructive system of taking large farms in partnership; a practice in a great degree necessary, while the husbandman

is so abjectly poor and unprovided ; but which always disappears in proportion as he acquires capital, and consequently the necessary mechanical implements of his profession. At present, the possession of the most necessary of all these implements, the plough, is, in several parts of the kingdom, by no means considered as essential to constitute a farmer : nay, even where a farm is taken by a number of wretched cottages in partnership, there frequently is not one in the whole colony. In general, they scratch the surface of their corn lands with the spade; and, where their fields are too extensive for this management, perhaps there are half a dozen ploughs in a parish, the owners of which earn their livelihood by hiring them out by the day at a very high rate.

SUPERSTITIOUS PRACTICES OF THE RUSSIANS.

THE Greek church equals the Latin church in ceremonies, and exceeds it in superstitious customs, which is not to say little. As these puerilities characterise the nations addicted to them, we will run over the principal. At the beginning of the year, the king's day is a singular festival, which the Russians call the Benediction of Waters. On the Neva, then frozen, there is raised for this ceremony, a kind of temple of an octagonal figure, on the top of which is a St. John the baptist, and the inside is decorated with pictures, representing the Baptism of Jesus, his transfiguration, and some other parts of his life. There your attention is drawn to an enormous Holy Ghost, appearing to descend from heaven, a decoration common to all the Greek churches. In the middle of the sanctuary is a square space, where the broken ice leaves a communication with the waters running below, and the rest is ornamented with rich tapestry. Around this temple there is erected a kind of gallery, which communicates with one of the windows of the imperial palace, at which the empress and her family come out to attend the ceremony, which begins as soon as the regiments of guards have taken post on the river. Then the archbishop, at the sound of the bells, and of the artillery of the fortrefs, comes out of the palace and walks in procession, with all his clergy, to the little temple we have just mentioned. When arrived at the place where the ice is broken, he descends, by means of a ladder, to the side of the water. There he dips his cross three or four times, afterwards says some prayers, an orison to the great St. Nicholas, and the waters are then thought blessed. The prelate sprinkles the water on the company around him, and on the colours of all the regiments that happen to be at St. Petersburg. After this benediction the archbishop retires, then the people crowd toward the hole, by which this prelate has blessed the waters. They drink of them with a holy avidity. Notwithstanding the cold, the mothers plunge their infants, and the old men their heads, into them. Every body makes it a duty to carry away some for the purification of their houses, and curing certain distempers, against which the good Russians pretend this holy water is a powerful specific. While every one proceeds to this useful provision, four popes, who are at the four corners of the sanctuary, sing a kind of litany, in which they rehearse all the titles of the empress, and to which the people answer by these words; *Pameloi-Bog—May God take pity on her.*

The Russians have a great number of abstinences, or fasts; among the rest, four lents. The first, which is their great lent, commences eight weeks before Easter. The second, called the lent of St. Peter, lasts five weeks and five days. The third is the lent of the mother of God, which begins on the first of August, and ends on the day of the assumption. The fourth is fixed for the fifteenth of November, and ends on Christmas-day. During the last week of this fourth lent, the tables of rigid observers are covered only with pots of a small size, and dishes not of a solid nature, because they say, Jesus, when he came into the world, could not use large pots, nor digest too solid meat. In their great lent they make use of nothing but butter and milk during the last week, which on that account is called *Masteniza*, or butter week. Besides their lents, the Wednesdays and Fridays of the whole year are fast days.

These good people think the abstinence broken, or at least very much altered, when a plate of meat has touched their lent plates. On Ash Wednesday, the popes do not blacken the brows of their congregations with ashes, but present them dishes composed of rice, sugar, honey, and raisins, which is the symbol of the abstinence to be observed in great lent. The lower class of people, during this lent, use nothing but linseed-oil, and sigh for Easter-day, as a thirsty man for a spring. They go to church on Holy Saturday at ten o'clock at night, stay there till twelve, and return home to indemnify themselves for lent, in a debauch, which commonly lasts till next day at noon. At the court, and among the rich who ape it, they breakfast on Easter morning at ten o'clock, on brandy, cheese, cake, and butter. That day, which is a great day of drunkenness for the Russians, the slaves present eggs to their lords, who can refuse neither them, nor the embrace they give them, telling them *Christ is risen*. The person embraced answers *Yes*, and accompanies his answer with some copecs.

During the feast of Pentecost, the Russian peasants plant maize, and strew flowers in their churches in honour of the Holy Ghost, and also in honour of spring. After mass, the priest preaches a kind of practical sermon, in which he mixes the gifts of the Holy Spirit with those of nature, which is going to be renewed; blesses the flowers, which the women and girls gather up to crown and ornament their houses with them.

On other festivals, and unfortunately there are many in Russia, divine service is performed there with much more pomp than in the Latin church. We were several times witnesses of this in the cathedral of St. Petersburg, where we saw the Archbishop of Moscow officiate, who bears the name of the celebrated Plato, and is almost as illustrious as he. He is a man of letters, and, though brought up in a cloister, has none of its prejudices.—We followed him to the church on the Sunday of Pentecost, where he performed the duties of pontiff in his finest robes. When he appeared in the choir, those who occupied the lobby thundered a hymn in the Greek language, which ended not till the prelate advanced towards the sanctuary, where he said a short prayer, and went afterwards to place himself on a kind of throne, erected in the middle of the church, where the priests were waiting for him, to invest him with his pontifical robes. He put off his *Mandias*, or ordinary coat; and, as they put on him the different parts of the dress he was to be decked with, he kissed them before

before they were laid on. They afterwards put on his head a crownⁿ enriched with jewels, and on his shoulders a cloak or robe not less^s rich. We were told that this dress was the same with the imperial robe which the Greek emperors formerly used, and in which the allowed the prelates to dress themselves when they officiated.

It was in this dress, that the archbishop passed into the sanctuary, and began service, a part of which was read by the priests in the Slavonian language, and the rest by the archbishop in the Greek; but he pronounced it, as the ritual directs, with the accent of the modern Greeks, in which there is nothing of the prosody of the ancients. We heard neither organ nor any musical instrument, because the Greek liturgy does not allow them; but the rhyme observed in singing the hymns produced a melody, with which the ear was very well entertained. We noticed that the luminary was not less than in the Latin church, and the censer was very much used. When the service was near a conclusion, the archbishop and the clergy went into the extremity of the sanctuary to communicate, which they did with the two representations, and the bread lifted up. During this ceremony, the doors of the sanctuary were shut, that no layman might participate. In the mean time, as strangers, we had permission to stand there. A protopope presented to the communicants, standing in two rows, a cup, in which was wine mixed with lukewarm water. Every one drank of it in his turn, the cup passing successively from the right row to the left, and every communicant was served with a bit of bread, in a spoon, which had been soaked in wine.

This ceremony, with the hymns and prayers which preceded and followed it, lasted a complete hour, and ended with a benediction which the archbishop gave the people. He then returned to put off his pontifical robes, on the seat on which he had been dressed in them.

The Greek priests have much more reverence and meditation in their way of going through divine service than the Latin priests; and the discipline of their church directs, that, when once a priest is at the altar, he must not remove from it, during the time he ought to stand there, whatever may happen to him. For instance, we were told that the Prelate Gabriel, at present metropolitan of Novogorod, and Archimandrit to St. Alexander Neufski, being one day engaged in saying mass at St. Petersburg, the house contiguous to the church took fire, and, the flames reaching the steeple, Gabriel was warned of the danger he was in, and yet he stirred not, even although he was told a second time, that the bells would not be long in bruising him to atoms. As the cries of the multitude, conjuring him to remove from certain death, made no impression on him, one of his relations leaped towards the altar and tore him from it. Scarcely was he twenty paces from it, when the steeple fell with a great crash upon the sanctuary. In relating this story, the Russians thought there was much courage in this prelate's conduct; but we saw in it nothing but fanatical obstinacy.

Russia for a long time had a patriarch, and, next to the czar, he was the most eminent person of the empire, and almost always equalled the czar by his pomp and influence, when he did not surpass him; for the Russians, before being regenerate, revered the patriarch and his priests like demi-gods.

This

This pontiff, to be legally installed, required to be confirmed by the patriarchs of Constantinople. Alexis Michaelowitsch assisted the ambitious Nikon in shaking off this yoke, and by that did a great service to his country, from which the patriarch of Constantinople, like a true priest, was in the practice of exacting money not his due.

In spite of the civilized state in which we believe the Russians are, it would be difficult to find a nation more superstitious; not even Spain nor Portugal exceeds it. The Russians eat no hares nor pigeons; the former because they are reputed unclean, and the latter because they are afraid of eating the Holy Ghost in the form of a dove. The ringing of the bells is for them an object of veneration, and they ascribe to it much efficacy for the saving of souls. On days of great solemnity, there are no cars able to bear the noise of the bells, which are put in motion at break of day, and are never suffered to rest till sun-set. They reckon it devotion to go and ring them, and on this account the cords of the most part reach to cottages before the churches, constructed expressly for the convenience of benevolent ringers.

Like the Spaniards and Italians, the Russians have small chapels in their houses in honour of the saint for whom they have a particular devotion. This saint of predilection is in Russia known under the name of bog, and no expence is grudged to decorate the chapel of a bog, which is always furnished with the richest luminary, when the proprietor has the ability. This childishness is not the rage of the common people alone. Noblemen, people in office, monasteries, all have their bogs, and at the highest price. What will be scarcely believed, but we can attest, because we have seen it, is that Mr. Scheremetoff, a member of the directing senate, has a cabinet of bogs worth more than a million of roubles: 222,222l. 4s. sterling.

Generally the saint or bog is painted on wood, and it is the diamonds, with which it is surrounded, that constitute its value. A Russian entering an apartment salutes nobody before he has made three cross signs before the bog of the house. The bogs most in fashion are St. Nicholas, St. John the Baptist, St. Sergius, and St. Alexander Neusk; yet the other saints are not without veneration, more or less, which is always settled by the pretended power attributed to them by ignorant superstition. For example, it is an opinion in this country that St. George watches particularly over horned beasts, and that St. Blaise is with God the patron and interpreter of other animals. Horses have St. Anthony, and St. Jonas is for the fishes, St. Aitippe is invoked for the toothach, St. Elias against thunder, and the Virgin for an infinite number of evils, and a very long patronage.

There are several cities in Russia, in which there are particular markets for selling bogs, and merchants when selling them avoid using the word buy. A bargain may be always made at the price they set on them, because it is a sin among them to ask too much, and we were also told that it was one to cheapen them. The wax-candles, or tapers, which they burn before the bogs, are the very reverse of our wax-tapers; they are thick at the top, and diminish towards the bottom. The popes say, that this form is given them, to imitate the visual ray of the saints, when they direct their eyes towards the earth. This solution, however insipid it may be thought, is not more

more so than the answers often made by the catholic priests to the indiscreet interrogatories of their devotees.

At a distance from the capital, the stupid and credulous are most ready to allow themselves to be imposed on by the first deceiver that attempts it. They are persuaded, for instance, if they are husbandmen or merchants, that, in order to succeed in planting or trading, such a bog's favour is necessary; that he will make their fortune, and must be hired for a certain time, during which the borrowed bog is grandly entertained and loaded with offerings, which must remain for the profit of the hirer.

In the worship paid to the bogs, devotees consider it an abomination to take tobacco in their presence, or to turn your back to them, when you are in conversation in a room where they have a chapel. There is also a certain time of year, when the wife must refrain from going to church, and above all from touching the bog; and, before the expiration of this critical time, she must be bathed before she presents herself before the bog.

Among the Russians the number of forty is sacred. It is the term of their civil and religious ceremonies. They study most carefully to show it in their accounts and conversations. Thus, instead of saying a rouble or twenty copecs, they say, forty altins. The tribute of Siberia in peltry is collected and put into packages of forty skins. The popes when reading the litany, are obliged at the conclusion to say forty times, without taking breath, *God have pity on us.*—Two of their lents are of forty days.

If you ask their theologians the reason of the predilection for this number, they answer, that Moses, Elias, and Jesus, fasted forty days; that the last did not ascend into heaven till forty days after his resurrection; that in the Old Testament many things were divided by forty, and particularly the life of Moses, in which are three remarkable periods of forty each. At the expiration of the first he was obliged to fly from Egypt; at the end of other forty years, he brought the children of Israel out of Egypt; and they wandered forty years in the wilderness. In short, they observe, that among the Israelites, and till this day among the Jews descended from them, the transgressors of the law received, and still receive, forty lashes with a whip. In conformity to such powerful reasons, it is astonishing they have not adopted the number seven, which among the Jews was much more mysterious than that of forty.

The Russian government does not tolerate the Jews, even under the reign of Catharine II. when the liberty of thinking is very philosophical. It excludes from offices the *Roskolniki*, the only sectaries that have taken place in Russia. They are the Quakers of that country. These sectaries, who among themselves are called *Staroverzi*, orthodox, or believers in the ancient faith (because the word *Roskolniki* signifies heretics), did not begin to make any noise in Russia, till towards the middle of the sixteenth century, and under the Patriarch Nikon, who, they maintain, was Antichrist. They differ from the other Greeks on some obscure points, the particulars of which we shall not speak of. We shall notice simply, that they do not consider the civil government, which distinguishes property, as a Christian institution. They maintain that all ought to be divided as among brethren, and are horrified at the worship of images, which they consider as idolatry; but what with justice makes them very ridiculous,

diculous, is, that in their eyes smoking tobacco is an abominable profanation. If any one is inconsiderate enough to indulge himself with it in their houses, as soon as he is gone, they open the doors and windows, sweep, rub, and clean all the house, but chiefly the place where this profane person sat or stood.

Peter I. who ought not to have paid any attention to them, gave them some celebrity, by occupying himself with them, and trying every method to bring them back to the Greek church. But, in him, who affected toleration, and thought it useful to the population of his dominion, which stood so much in need of population, it was unpardonable to have employed torture for converting them. Above all, he deserves to be severely blamed for the punishment of the unfortunate Toma, who ought to have been confined, not given up to the flames.

This madman, who was priest in his sect, and consequently must have been the greater fanatic, took it into his head one day to preach openly in a church in Moscow, against the invocation of saints, and some other dogmas of the religion called predominant.

The popes, it is said, gently invited Toma to retire, which he did, but it was only to return armed with a hatchet, with which he cut in pieces the images of St. Alexis and the Virgin. This action unquestionably shewed him to be mad, and, as being such, he ought to have been confined, and some attempts made to cure him; but the popes, who were a while ago so moderate, caused him to be arrested, and Peter ordered him to be burnt alive. Toma, after having heard his sentence read, with that sullen indifference, inspired by the fanaticism which pursues its death, saw his hand, which had carried the hatchet, consumed by the fire without uttering a sigh; got upon the pile, and expired, declaiming against the popes, and the abuses they had introduced into religion. Peter, they say, was so struck with the manner in which this poor man had suffered his punishment, that he repented of having given his consent to it, and issued an order forbidding the persecution of the Roskolniki, but commanding them to wear a sort of red hood, to distinguish them from his other subjects; as if these poor creatures with this mark of proscription ought to have been less dear than those from whom they differed in opinion. Like the rest of his subjects, did not they pay taxes, and did not they go out to war when the prince called them? Catharine II. whom Voltaire has praised so highly for toleration, but on what grounds we know not; Catharine II. has not suppressed the hood of the Roskolniki.

NATURE AND ORIGIN OF THE CUSTOMS.

THE considerations upon which the revenue of the Customs (or the more ancient part of it, which arose only from exports) was invested in the king, were said to be two: 1. Because he gave the subject leave to depart the kingdom, and to carry his goods along with him. 2. Because the king was bound of common right to maintain and keep up the ports and havens, and to protect the merchants from pirates. Some have imagined they are called with us customs, because they were the inheritance of the king by immemorial usage and the common law, and not granted him by any statute: but Sir Edward Coke hath clearly shewn, that the king's first claim to them was

was by grant of parliament 3 Edw. I. though the record thereof is not now extant. And indeed this is in express words confessed by statute 25 Edw. I. c. 7. wherein the king promises to take no customs from merchants, without the common assent of the realm, "saving to us and our heirs the customs on wool, skins, and leather, formerly granted to us by the commonalty aforesaid." These were formerly called *hereditary customs* of the crown; and were due on the exportation only of the said three commodities, and of none other: which were styled the *staple* commodities of the kingdom, because they were obliged to be brought to those ports where the king's staple was established, in order to be there first rated, and then exported. They were denominated, in the barbarous Latin of our ancient records, *custuma*, (an appellation which seems to be derived from the French word *coutum* or *coutum*, which signifies toll or tribute, and owes its own etymology to the word *cost*, which signifies price, charge, or, as we have adopted it in English, *cost*;) not *consuetudines*, which is the language of our law whenever it means merely usages. The duties on wool, sheep-skins or woolfells, and leather, exported, were called *custuma antiqua sive magna*, and were payable by every merchant, as well native as stranger; with this difference, that merchant-strangers paid an additional toll, viz. half as much again as was paid by natives. *Custuma parva et nova* were an impost of 3d. in the pound, due from merchant-strangers only, for all commodities as well imported as exported; which was usually called the *alien's* duty, and was first granted in 31 Edw. I. But these ancient hereditary customs, especially those on wool and woolfells, came to be of little account, when the nation became sensible of the advantages of a home manufacture, and prohibited the exportation of wool by statute 11 Edw. III. c. 1.

Other customs payable upon exports and imports were distinguished into subsidies, tonnage, poundage, and other imposts. Subsidies were such as were imposed by parliament upon any of the staple commodities before-mentioned, over and above the *custuma antiqua et magna*: tonnage was a duty upon all wines imported; over and above the prisage and butlerage aforesaid; poundage was a duty imposed *ad valorem*, at the rate of twelve-pence in the pound, on all other merchandize whatsoever, and the other imposts were such as were occasionally laid on by parliament, as circumstances and times required. These distinctions are now in a manner forgotten, except by the officers immediately concerned in this department; their produce being in effect all blended together, under the one denomination of the *customs*.

By these we understand, at present, a duty or subsidy paid by the merchant at the quay upon all imported as well as exported commodities, by authority of parliament; unless where, for particular national reasons, certain rewards, bounties, or drawbacks, are allowed for particular exports or imports. The customs thus imposed by parliament are chiefly contained in two books of rates, set forth by parliamentary authority; one signed by Sir Harbottle Grimston, speaker of the house of commons in Charles II's time; and the other an additional one, signed by Sir Spencer Compton, speaker in the reign of George I. to which also subsequent additions have been made. Aliens pay a larger proportion than natural subjects, which is what is now generally understood by the *aliens* duty; to be

exempted from which is one principal cause of the frequent applications to parliament for acts of naturalization.

These customs are then a tax, immediately paid by the merchant, although ultimately by the consumer. And yet these are the duties felt least by the people: and, if prudently managed, the people hardly consider that they pay them at all. For the merchant is easy, being sensible he does not pay them for himself; and the consumer, who really pays them, confounds them with the price of the commodity; in the same manner as Tacitus observes, that the Emperor Nero gained the reputation of abolishing the tax of the sale of slaves, though he only transferred it from the buyer to the seller; so that it was, as he expresses it, *remissum magis specie, quam vi: quia cum venditor pendere juberetur, in partem pretii emptoribus accrescebat*. But this inconvenience attends it on the other hand, that these imposts, if too heavy, are a check and cramp upon trade; and especially when the value of the commodity bears little or no proportion to the quantity of the duty imposed. This in consequence gives rise also to smuggling, which then becomes a very lucrative employment: and its natural and most reasonable punishment, viz. confiscation of the commodity, is in such cases quite ineffectual; the intrinsic value of the goods, which is all that the smuggler has paid, and therefore all that he can lose, being very inconsiderable when compared with his prospect of advantage in evading the duty. Recourse must therefore be had to extraordinary punishments to prevent it; perhaps even to capital ones: which destroys all proportion of punishment, and puts murderers upon an equal footing with such as are really guilty of no natural, but merely a positive, offence.

There is also another ill consequence attending high imposts on merchandize, not frequently considered, but indisputably certain; that the earlier any tax is laid on a commodity, the heavier it falls upon the consumer in the end; for every trader, through whose hands it passes, must have a profit, not only upon the raw material and his own labour and time in preparing it, but also upon the very tax itself, which he advances to the government; otherwise he loses the use and interest of the money which he so advances. To instance in the article for foreign paper. The merchant pays a duty upon importation, which he does not receive again till he sells the commodity, perhaps at the end of three months. He is therefore equally intitled to a profit upon that duty which he pays at the custom-house, as to a profit upon the original price which he pays to the manufacturer abroad; and considers it accordingly in the price he demands of the stationer. When the stationer sells it again, he requires a profit of the printer or bookseller upon the whole sum advanced by him to the merchants: and the bookseller does not fail to charge the full proportion to the student or ultimate consumer; who therefore does not only pay the original duty, but the profits of these three intermediate traders, who have successively advanced it for him. This might be carried much farther in any mechanical, or more complicated, branch of trade.

REMARKABLE ACCOUNT OF THE LAND CRAB.

[*Extracted from Dr. Sibly's Wonders of Nature.*]

THE land crab inhabits the Bahama Islands, as well as most parts between the tropics, and feeds upon vegetables. These creatures live not only in a kind of orderly society in their retreats in the mountains, but regularly once a year march down to the sea-side in a body of some millions at a time. As they multiply in great numbers, they choose the month of April or May to begin their expedition; and then sally out by thousands from the stumps of hollow trees, from the clefts of rocks, and from the holes which they dig for themselves under the surface of the earth. At that time the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading upon them. The sea is their place of destination, and to that they direct their march with right-lined precision. No geometrician could send them to their destined station by a shorter course; they neither turn to the right nor to the left, whatever obstacles intervene; and even if they meet with a house, they will attempt to scale the walls to keep the unbroken tenor of their way. But, though this be the general order of their route, they, upon other occasions, are obliged to conform to the face of the country; and, if it is intersected with rivers, they are then seen to wind along the course of the stream. The procession sets forward from the mountains with the regularity of an army under the guidance of an experienced commander. They are commonly divided into three battalions; of which the first consists of the strongest and boldest males, that, like pioneers, march forward to clear the route and face the greatest dangers. These are often obliged to halt for want of rain, and to go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time, and then descend in regular battalia, being formed into columns of fifty paces broad, and three miles deep, and so close that they almost cover the ground. Three or four days after this, the rear-guard follows, a straggling undisciplined tribe, consisting of males and females, but neither so robust nor so vigorous as the former. The night is their chief time of proceeding; but, if it rains by day, they do not fail to profit by the occasion; and they continue to move forward in their slow uniform manner. When the sun shines and is hot upon the surface of the ground, they then make an universal halt, and wait till the cool of the evening. When they are terrified, they march back in a disorderly manner, holding up their nippers, with which they sometimes tear off a piece of the skin, and then leave the weapon where they inflicted the wound. They even try to intimidate their enemies; for they often clatter their nippers together, as if it were to threaten those that come to disturb them. But, though they thus strive to be formidable to man, they are much more so to each other; for they are possessed of one most unsocial property, which is, that, if any of them by accident is maimed in such a manner as to be incapable of proceeding, the rest fall upon and devour it on the spot, and then pursue their journey.—When, after a fatiguing march, and escaping a thousand dangers,

(for they are sometimes three months in getting to the shore,) they have arrived at their destined port, they prepare to cast their spawn. The peas are as yet within their bodies, and not excluded, as is usual in animals of this kind, under the tail; for the creature waits for the benefit of sea-water to help the delivery. For this purpose the crab has no sooner reached the shore, than it eagerly goes to the edge of the water, and lets the waves wash over its body two or three times. This seems only a preparation for bringing their spawn to maturity; for, without further delay, they withdraw to seek a lodging upon land; in the mean time the spawn grows larger, is excluded out of the body, and sticks to the barbs under the flap, or more properly the tail. This bunch is seen as big as a hen's egg, and exactly resembling the roes of herrings. In this stage of pregnancy they once more seek the shore for the last time; and, shaking off their spawn into the water, leave accident to bring it to maturity. At this time whole shoals of hungry fish are at the shore in expectation of this annual supply; the sea to a great distance seems black with them; and about two thirds of the crabs eggs are immediately devoured by these rapacious invaders. The eggs that escape are hatched under the sand; and, soon after, millions at a time of the little crabs are seen quitting the shore, and slowly travelling up to the mountains. The old ones however are not so active to return; they have become so feeble and lean, that they can hardly creep along, and the flesh at that time changes its colour. The most of them, therefore, are obliged to continue in the flat parts of the country till they recover, making holes in the earth, which they cover at the mouth with leaves and dirt, so that no air may enter. There they throw off their old shells, which they leave, as it were, quite whole; the place where they opened on the belly being unseen. At that time they are quite naked, and almost without motion for six days together, when they become so fat as to be delicious food. They have then under their stomachs four large white stones, which gradually decrease in proportion as the shell hardens, and, when they come to perfection, are not to be found. It is at that time that the animal is seen slowly making its way back; and all this is most commonly performed in the space of six weeks. This animal, when possessed of its retreats in the mountains, is impregnable; for, only subsisting on vegetables, it seldom ventures out; and, its habitation being in the most inaccessible places, it remains for a great part of the season in perfect security. It is only when impelled by the desire of bringing forth its young, and when compelled to descend into the flat country, that it is taken. At that time the natives wait for its descent in eager expectation, and destroy thousands; but, disregarding their bodies, they only seek for that small spawn which lies on each side of the stomach within the shell, of about the thickness of a man's thumb. They are much more valuable upon their return after they have cast their shell; for, being covered with a skin resembling soft parchment, almost every part except the stomach may be eaten. They are taken in the holes by feeling for them with an instrument; they are sought after by night, when on their journey, with flambeaux. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most terribly whatever it happens to fasten on. But the dexterous crab-catcher takes them by the hinder legs in such a manner that the nippers can-

not

not touch him, and thus he throws them into his bag. Sometimes also they are caught when they take refuge in the bottom of holes in rocks by the sea-side, by clapping a stick to the mouth of the hole, which prevents their getting out; and then soon after, the tide coming enters the hole, and the animal is found, upon its retreating, drowned in its retreat.—These crabs are of various sizes, the largest about six inches wide; they walk side-ways like the sea-crab, and are shaped like them: some are black, some yellow, some red, and others variegated with red, white, and yellow, mixed. Some of these are poisonous; and several people have died of eating of the crabs, particularly of the black kind. The light-coloured are reckoned best; and, when in full flesh, are very well tasted. In some of the sugar-islands they are eaten without danger; and are no small help to the negro slaves, who, on many of these islands, would fare very hard without them.

RULES FOR THE PRESERVATION OF THE SIGHT.

THOUGH it may be impossible to prevent the absolute decay of sight, whether arising from age, partial disease, or illness, yet by prudence and good management, its natural failure may certainly be retarded, and the general habit of the eyes strengthened, which good purposes will be promoted by a proper attention to the following maxims:

1. Never to sit for any length of time in absolute gloom, or exposed to a blaze of light. The reasons on which this rule is founded, prove the impropriety of going hastily from one extreme to the other, whether of darkness or of light, and shew us, that a southern aspect is improper for those whose sight is weak and tender.

2. Not to read in the dusk; nor, if the eyes be disordered, by candle-light. Happy those who learn this lesson betimes, and begin to preserve their eyes, before they are reminded, by pain, of the necessity of sparing them; the frivolous attention to a quarter of an hour of the evening has cost numbers the perfect and comfortable use of their eyes for many years: the mischief is effected imperceptibly, the consequences are inevitable.

3. The eye should not be permitted to dwell on glaring objects, more particularly on first waking in a morning; the sun should not of course be suffered to shine in the room at that time, and a moderate quantity of light only be admitted. It is easy to see, that, for the same reasons, the furniture of a bed should be neither altogether of a white or red colour; indeed, those whose eyes are weak would find considerable advantage in having green for the furniture of their bed-chamber. Nature confirms the propriety of the advice given in this rule: for the light of the day comes on by slow degrees, and green is the universal colour she presents to our eyes.

4. The long-sighted should accustom themselves to read with rather less light, and somewhat nearer to the eye, than what they naturally like; while those that are short-sighted, should rather use themselves to read with the book as far off as possible. By this means, both would improve and strengthen their sight; while a contrary course will increase its natural imperfections.

There is nothing which preserves the sight longer, than always using, both in reading and writing, that moderate degree of light which is best suited to the eye; too little strains them, too great a quantity

quantity dazzles and confounds them. The eyes are less hurt by the want of light than by the excess of it: too little light never does any harm, unless they are strained by efforts to see objects to which the degree of light is inadequate; but too great a quantity has, by its own power, destroyed the sight. Thus many have brought on themselves a cataract, by frequently looking at the sun, or a fire; others have lost their sight, by being brought too suddenly from an extreme of darkness into the blaze of day. How dangerous the looking upon bright luminous objects is to the sight, is evident from its effects in those countries which are covered the greater part of the year with snow, where blindness is exceedingly frequent, and where the traveller is obliged to cover his eyes with crape, to prevent the dangerous and often sudden effects of too much light: even the untutored savage tries to avoid the danger, by framing a little wooden case for his eyes, with only two narrow slits. A momentary gaze at the sun will, for a time, unfit the eyes for vision, and render them insensible to impressions of a milder nature.

The following cases, from a small tract on the "*Fabric of the Eye*," are so applicable to the present article, as to want no apology for their insertion here; though, if any were necessary, the use they will probably be to those whose complaints arise from the same or similar causes, would, I presume, be more than sufficient.

"A lady from the country, coming to reside in St. James's-square, was afflicted with a pain in her eyes, and a decay of sight. She could not look upon the stones, when the sun shone upon them, without great pain. This, which she thought was one of the symptoms of her disorder, was the real cause of it. Her eyes, which had been accustomed to the verdure of the country, and the green of the pasture grounds before her house, could not bear the violent and unnatural glare of light reflected from the stones; she was advised to place a number of small orange-trees in the windows, so that their tops might hide the pavement, and be in a line with the grass. She recovered by this simple change in the light, without the assistance of any medicine, though her eyes were before on the verge of little less than blindness."

"A gentleman of the law had his lodgings in Pall Mall, on the north side; his front windows were exposed to the full noon sun, while the back room, having no opening but into a small close yard, surrounded with high walls, was very dark: he wrote in the back room, and used to come from that into the front room to breakfast, &c. — His sight now grew weak, and he had a constant pain in the balls of his eyes; he tried visual glasses, and spoke with oculists, equally in vain. Being soon convinced, that the coming suddenly out of his dusky study into the full blaze of sun-shine, and that very often in the day, had been the real cause of his disorder, he took new lodgings, by which, and forbearing to write by candle-light, he was very soon cured."

Blindness, or at least miserable weaknesses of sight, are often brought on by these unsuspected causes. Those who have weak eyes, should therefore be particularly attentive to such circumstances, since prevention is easy, but the cure may be difficult, and sometimes impracticable.

When the eye sensibly flattens, all delay is dangerous; and the longer those who feel the want of assistance defer the use of spectacles,

tacles, the more they will increase the failure of the eye; there are too many who procrastinate the use of them, till at last they are obliged to use glasses of ten or twelve inches focus, instead of those of thirty-six or forty, which would otherwise have suited them; thus preferring a real evil, to avoid one that is imaginary. A late author mentions several deplorable cases of this kind; particularly one of a lady, who, through false shame, had abstained from wearing spectacles so long a time, that at last it was impossible to suit her, but with those adapted to eyes that have been couched. Whereas the instances are numerous of those who, by using glasses of a long focus at the first approaches of long-sightedness, have brought back their natural sight, and been able to lay aside their spectacles for years.

The most general and perhaps the best rule that can be given, to those who are in want of assistance from glasses, in order so to choose their spectacles, that they may suit the state of their eyes, is to prefer those which shew objects nearest their natural state, neither enlarged nor diminished, the glasses being near the eye, and that give a blackness and distinctness to the letters of a book, neither straining the eye, nor causing any unnatural exertion of the pupil.

For no spectacles can be said to be properly accommodated to the eyes, which do not procure to them ease and rest: if they fatigue the eyes, we may safely conclude, either that we have no occasion for them, or that they are ill made, or not proportioned to our sight.

Though, in the choice of spectacles, every one must finally determine for himself, which are the glasses through which he obtains the most distinct vision; yet some confidence should be placed in the judgment of the artist of whom they are purchased, and some attention paid to his directions. By trying many spectacles the eye is fatigued, as the pupil varies in size with every different glass, and the eye endeavours to accommodate itself to every change that is produced. Hence, the purchaser often fixes upon a pair of spectacles, not the best adapted to his sight, but those which seem to relieve him most while his eyes are in a forced and unnatural state; and consequently, when he gets home, and they are returned to their natural state, he finds what he has chosen fatiguing and injurious to his sight.

ON MAGICAL SUPERSTITIONS.

PERE le Brun, a religious rather than a philosophical writer, in his 'Superstitions ancient and modern,' has given an ample detail of the various kinds of magic. To me it appears, that his belief in what he calls diabolical magic was great, at the same time that he perceived the impositions of the artful and the follies of the credulous.

He divides magic into three parts; natural, artificial, and diabolical.—Natural magic produces extraordinary and wonderful effects by the simple power of nature; as when the father of Tobias was healed of his blindness by using the gall of that fish which rushed from the Tigris to devour his son.—Artificial magic likewise produces uncommon and wonderful effects, accomplished by the labours of human industry; as the glass sphere of Archimedes; the flying dove of Architas; the golden bird of the Emperor León, which

was said to sing; the speaking head of Albert the Great; the serpents of brass of Boethius, which hissed; the invulnerable knight of Burgarius; the tripods of Vulcan; the vegetable tree of chemists; that iron fly which was presented to Charles the Vth by John of Montroyel, and which, having flown round him, alighted on his arm; automats, and other similar ingenious operations.—Diabolical magic, he informs us, is performed by the aid of demons, with whom forcerers enter into a social compact. Of this magic I shall not notice the several instances he gives, notwithstanding that they are sanctioned by the testimonies of some of the ancient fathers and saints!

Natural and artificial magic are of themselves innocent. But they may become accidentally pernicious, when they are employed for some artful design, and for a bad purpose. It is then they lead men into vile superstitions; otherwise they are certainly not to be considered as such.

Diabolic or black magic is ever superstitious; because it always supposes a pact with demons. Here the author establishes the existence of this magic by a variety of examples drawn from the holy writings, those of the fathers, and even of historians. It is impossible to deny that such narratives are frequently given; but the degree of credit which is due to them, it remains for the judgment of the discerning to fix.

Le Brun proceeds in giving a list of those remarkable men who have been accused of magic. Both the Jews and Pagans treated Jesus Christ as a magician; and other celebrated characters shared in the same fate, such as Zoroaster, Pythagoras, Mahomet, Agrippa, Faustus, Luther, &c. nothing indeed is more dangerous than to exert in study in an age of profound ignorance.

He then shews, that magic or witchcraft is expressly condemned by all laws both divine and human; this he does by numerous quotations from the holy writings, from those of the fathers, and various councils; and also notices that the code of Justinian affords several civil regulations against forcerers.

He afterwards transcribes from Bodin, the fifteen crimes of which the latter informs us all forcerers are guilty. Of most of these charges it is to be acknowledged that any man may be accused, who is no conjuror; such as, their occasioning a famine; the death of cattle; their amours with Satan; hymeneal unions with him in fens and marshes! It is probably true, indeed, that the following enormous crimes were committed by those wretched men, who deluded themselves into a belief that by such actions they might become the favourites of the power to whom they devoted themselves. These forcerers have been well known (even by their own confession) to have sacrificed to the devil their infants, before they were baptised, holding them in the air, and thrusting a large pin into their heads, which occasioned their deaths. Springer informs us, that he burnt one who had thus destroyed forty-one children. Another crime is not less dreadful; these forcerers, not satisfied with sacrificing to the devil their own children, and burning them by way of sacrifice, also consecrated them to Satan even while they were yet in the bowels of their mother, as did the Baron of Saiz, who sacrificed his child in this unborn state. All this appears from his own confession. Again, they committed incest, because it was reported currently amongst them,

them, that the greatest magicians are produced from an union with a father and his daughter, a mother and her son. Other crimes, not less detestable, are laid to their charge; which are not improbable. —But I have said enough to give an idea of the unhappy effects which sorcery really produced, when it prevailed in the ages of ignorance.

To render this article more complete, it would not be improper to give a sketch of the various superstitions sorcery gave rise to; but the instances are so numerous, and the divisions are so nice, that it is impossible to compress them into any tolerable compass. I shall notice the most curious.

Sometimes these superstitions are classed under the title of Phylacteries, or preservatives. Le Brun divides them into two kinds; the one employed without words, and the other with words.

In the first class are to be placed the Talismans, which are certain figures invented by the Arabians, engraved on certain stones or metals. To make these Talismans perfect, according to the minute description of an adept, and which is inserted in this work, so many wonderful things are required, that any one, in the least in his senses, must despair of accomplishing his purpose. Yet the same adept enumerates a variety of instances of their miraculous powers. He informs us of their potency as remedies, and prescribes them as excellent for the head-ach, the sore-throat, rheumatisms, &c. and, what is very essential, they will assist us in becoming agreeable to the ladies, in acquiring riches and honours, in being successful in commerce or gaming; to be men of genius, &c.—The reader's curiosity is probably awakened; I have transcribed one of his recipes, on a subject in which most aspire to be successful.

‘R FOR JOY, BEAUTY, AND STRENGTH.

Engrave the figure of Venus, which is a lady holding in her hands apples and flowers, in the first scale of Libra, or of Pisces, or of Taurus.—This is no difficult operation; but the reader must first obtain the perfect Talisman, on which it is to be engraved.

Of the effects of these Talismans there are numerous instances recorded by old writers; but I shall not venture to transcribe them.

One I am induced to notice. It was said that the cells of the Chartreux were never troubled with bugs; though they had been discovered in the cells of their domestics. Several religionists cherished an opinion that this was owing to a particular exemption with which God favoured the order! These are the literal expressions of father Jaques du Breul:—‘God would not allow them to be afflicted and distressed by those stinking animals called bugs; and, to shew his peculiar favour, he has not exempted the cells of their servants from these creatures.’—This was a subject of serious controversy among the scholars of those days; and some attributed the exemption to the use of Talismans. Cardan, more philosophically, to their not eating meat; Scaliger rallies him on this, but gives no reason for it; at length Vossius, in his work on Idolatry, mentions this fact as very uncertain, while he at the same time brings the best proof of it, which simply proceeded from the act of cleaning their cells daily!

Another of the same kind of phylacteries were the Gamahez, that is natural figures found in stones, marble, metals, &c. things by no

means uncommon; perhaps every virtuoso has one in his cabinet. Also all natural productions resembling artificial compositions.

The same spirit of superstition has formed another kind of magic; which consists in certain words and expressions, sometimes accompanied by certain actions. Such as, when men were exposed to storms, lightning, &c. they drew a circle on the earth with a knife, capable of containing those they desired to protect. Then they made a cross, and wrote *Verbum caro factum est*.—Characters more diabolical are framed, by which Le Brun informs us they pretend to corrupt the morals of the fair. Then he gives a prolix account of certain enchanted medals. But I am weary of collecting these superstitious follies; enough has been exhibited to remind the reader to what a deplorable degree the human mind can sink, when it labours under a load of superstitious imaginations.

In another chapter, he displays the various superstitions of men who think they shall be fortunate at play, if they wear a piece of the cord of a hanged man; a trefoil that has four leaves; and the heart of a swallow. Le Brun informs us, that none of these can have the effect proposed, unless they are influenced by his sable highness, and that of course such practices must be vile magic. Again, he notices that skin which covers the heads of some when they are born, generally named a child's caul, which, even in the present day, we see advertised, and for which, not many years back, exorbitant prices have been given. An old adage observes of a fortunate man, that he was born with a caul. It is a superstition of an ancient date; for Le Brun observes, that in Rome, some of the advocates bought, at very high prices, these cauls, persuaded they would bestow on them all the eloquence of Cicero. Some persons, he says, keep throughout the year all the eggs laid on good Friday; he proceeds with a hundred similar practices; all which, the honest father informs us, can have no power unless the devil is invoked for an assistant.

The arguments with which they combated these magical superstitions are more worthy of our reflection; we shall be surprised at the acuteness displayed on subjects, which in the present age do not even admit of discussion.

Of several of these animadversions, I shall notice what Du Laurent, physician to Henry III. of France, observes on the virtue of magical words, of which he denies the existence in medicine. That words have no virtue of themselves, he proves by several subtil reasons, of which these are some:—Words are mere quantities; now quantity has no virtue to act.

Words are written or pronounced. Those which are written are dead and unanimated; those which are pronounced only touch the air. Now, sound has no more power to affect the feeling than colour has to affect the hearing; so that, as the feeling must be changed in the cure of wounds, words cannot possibly effect this change.

If words had any virtue, they would derive it from their form or matter. From their form they can have none, because that is artificial, and dependent on the institutions of men, and consequently it is only known by those who have established it. Their matter is but a vapour, a breath, mere air, which is not always of the same nature, but which changes according to the various constitutions of the heart, lungs, and the other necessary organs of speech.

You

You will say (he makes this objection to himself) that words have a wonderful effect on the minds of men; that they have power to change their passions. The tongue, says the apostle James, is but a small part of the body, yet what great things does it not effect? Is not a little fire sufficient to kindle a great quantity of wood? Are not ships turned on all sides by a small rudder?—To all this I answer, that words indeed excite the passions of the soul, and can totally change the intentions of the mind, not however by themselves, but by the things which they signify; by the weight of maxims or observations they contain. But it generally happens, that the words uttered by charmers are only barbarous and ridiculous ones, which have no signification, order, or cadence. So that they can neither affect the mind or body.

Patin observes, at a time when magic was more common than at present, that there are more female forcerers than males, which he attributes to the feebleness and curiosity of the female mind.

Excommunicated persons, partakers of the crime, infants, wicked servants, and runaways, are to be admitted to bear witness against their mistresses, because (says Bodin, the great champion of witchcraft) no honest person is capable of detecting them. And, though by law no single witness is allowed against an accused person, yet if one depose that a witch has bewitched her cow, her sow, or her butter, these are to be accepted as so many testimonies against the witch; because they are not single witnesses!

But the most dreadful witness against a witch appears to have been herself. A lean, deformed, melancholy, old woman, worried by the children of the village, and odious by her sour disposition to all her neighbours, was frequently prompted, by a denial of a little milk or fragments of victuals, on which alone she lived, to utter a curse upon the master, child, servant, or any other animal, belonging to the house; so that in process of time all the family, to the very pigs in the sty, have been cursed by her. A child is convulsed, a neighbour has a fever, or a horse is glandered; instead of sending for a physician or a farrier, they only think of the poor old wretch to whom they denied a morsel of bread. She is accused. The old woman has just as much ignorance and credulity as her neighbours; she knows she has cursed, and she believes her curses to have taken place. She does not deny that she is a witch; and she is burnt by her own evidence!

This subject is copious, and interesting to a philosophical mind, who takes the same pleasure in contemplating the termination of the past follies of humanity as another receives from attending to the fifth act of a play. This topic has been conducted in a very superior investigation by Reginald Scot, in his 'Discoverie of Witchcraft. Third edition, 1665.' A work as elaborate as curious; which stopt for a time the superstitious dispositions of our nation in the reign of Elizabeth. A treatise which, though it displays the singular ingenuity of its author as advantageously as it does his profound erudition, instead of meeting with a patron in the royal pedant, James I. could make no friend at court. Scot, the apostle of humanity, the legislator of reason, lived in retirement, but persecuted by religious credulity and legal cruelty.

THE INSTRUCTIVE NATURALIST, No. II,

ON THE PROPERTIES OF DIGESTION.

AS RESPIRATION succeeds the placenta in one of its offices by maintaining life, the function of DIGESTION succeeds it in another, by either continuing or supporting the growth of the living body. It depends on respiration for a portion of heat, and is that function by which the liquid and solid food undergoes its first preparation in the system.

Though gaseous fluids, including the principles of heat and light, may be proved to nourish and compose the substances of all living bodies, yet a part only can enter the system in a gaseous state. This part is changed by the lungs, or by those fluids which they contain. The organs of digestion, before they can act on aerial bodies, must have them reduced to some new form. For the food of vegetables, this form requires to be water, whose one hundred parts are found to consist of eighty-four fourths of oxygene and fifteen one fifth of hydrogene.

When these gases have passed through both the watery and vegetable states, they, as juices or solids, become the food of a great many animals. These animals produce new changes, and by their preparation the gases become the food of others which are called carnivorous; and then the carnivorous and all living bodies, when the vivifying principle has ceased within them, and when they are hastening to a state of dissolution, are devoured by others who feed on corruption, are partly converted into water and gas, and become in their turn the food of the kinds on which they had fed.

As these effects of the digesting and assimilating powers are more surprising than any chemical process of art, it may not be unpleasing to take a more particular view of them. It has long been observed, that those animals which are not carnivorous feed upon plants; and, since the days of Van Helmont and Boyle, it has been suspected that plants live upon water and air. This suspicion has now been confirmed by numerous experiments. Plants have been raised from distilled water without earth, and, instead of requiring a vegetable mould, have spread their roots in moss, in paper, in cotton, in pieces of cloth, in pounded glass, and powder of quartz. From these facts, the ingenious Chaptal has been led to suppose that soils act but as so many sponges, affording water in different proportions, and in different ways; and that all that the plant wants from the soil is a firm support, a permission to extend its roots where it chooses, and that proportioned supply of humidity which will secure it against the alternatives of being inundated or dried up. To answer, however, these several conditions, he allows it to be necessary in many cases "to make a proper mixture of the primitive earths, as no one in particular possesses them. Siliceous and calcareous earths may be considered as hot and drying, the argillaceous as moist and cold, and the magnesian as possessing intermediate properties. Each, in particular, has its faults, which render it unfit for culture. Clay absorbs water, but does not communicate it; calcareous earth receives and gives it too quickly; but the properties of these earths are so happily opposed, that they correct each other by mixture. Accordingly we find,

find, that by adding lime to an argillaceous earth, this last is divided, and the drying property of the lime mitigated, at the same time that the stiffness of the clay is diminished. On these accounts it is that a single earth cannot constitute manure, and that the character of the earth intended to be meliorated ought to be studied before the choice of any addition is decided on. The best proportions of a fertile earth for corn are three eighths of clay, two eighths of sand, and three eighths of the fragments of hard stone.

The advantages of labour consist in dividing the earth, aerating it, destroying useless or noxious plants, and converting them into manure by facilitating their decomposition."

So far is vegetable mould from communicating any thing new to plants, that it rather owes its formation to them; and, if sea-salt should at times be requisite to marine vegetations, it is to be remembered that salts, sulphur, and lime, are all products of organized bodies; that iron itself has been discovered in plants and animals; and that even diamonds, quartz, crystals, spars, gypsum, &c. are found only in those earths that are partly composed of an impoverished vegetable residue, which provident nature seems to have reserved for the reproduction or reparation of the earthy and metallic substances of the globe; while the vegetable mould on these organic parts that remain are made to serve as nourishment for the growth of succeeding plants.

If those earths in which plants are reared, and which contain no vegetable mould, should ever be sensibly diminished in weight, a circumstance, we believe, which seldom takes place if proper precaution be used to prevent it; yet, if it should happen, it should not in that case be forgotten that gases are the general cements in nature; that they mix intimately with the hardest bodies; and that this sensible diminution of weight may be owing entirely to some dissolution of the solid parts, and the consequent extrication of the gaseous fluids.

"Before we had acquired a knowledge of the constituent principles of water," resumes Chaptal, "it was impossible to explain or even to conceive the growth of plants by this single aliment. In fact, if the water were an element, or indecomposable principle, it would afford nothing but water in entering into the nutrition of the plant, and the vegetable would of course exhibit that fluid only; but, when we consider water as formed by the combination of the oxygenous and hydrogenous gases, it is easy understood that this compound is reduced to the principles, and that the hydrogenous gas becomes a principle of the vegetable, while the oxygene is thrown off by the vital forces. Accordingly we see the vegetable almost entirely formed of hydrogen. Oils, resins, and mucilage, consist of scarcely any thing but this substance; and we perceive the oxygenous gas escape by the pores where the action of light causes its disengagement."

But, though water constitutes the aliment of plants, we must not suppose that it is the aliment of these alone: the leech and the tadpole are nourished by water, and many animals have no other food. "Rondelet cites a great number of examples of marine animals which cannot subsist but by means of water by the very constitution of their organs. He affirms, that he kept during three years a fish in a vessel constantly maintained full of very pure water.

It grew to such a size, that at the end of that time the vessel could no longer contain it. He relates this as a very common fact. We likewise observe the red fishes which are kept in glass vessels, are nourished, and grow, without any other assistance than that of water properly renewed."

The ingenious Borelli, who knew that plants and several animals subsisted wholly by water and air, was likewise of opinion that some animals lived upon sand. He could discover nothing but sand in the stomachs of many testaceous animals that live in the water, and particularly in the stomachs of the smaller kinds that live buried in the sand of the sea. He could not conceive what else could be the food of those small fishes or worms which penetrate the substance of the hardest rocks, and form excavations that always bear a proportion to their bulk. He had regularly found that the stomachs of swans which he had examined were full of sand; and, recollecting the pebbles in the gizzards of fowls, he was led to infer that these substances were somehow dissolved in a gastric juice, and served to nourish the harder parts, as the shells, the feathers, and the bones. These sentiments, on a slight view, might not be unnatural. From observing children of depraved appetites swallowing sand, ashes, and cinders; from having sometimes met with sand in the stomachs of wild-ducks; from the usual fæces of the earth-worm; and from the dissection of several toads dug up in a garden, in whose stomachs could be found nothing but a quantity of earth, with pieces of coal, stone, and of slate, that had accidentally happened to be mixed with it, we long entertained a similar opinion with this celebrated author: but on recollecting that many substances which enter the stomach are not nutritious; considering the balls of hair and of feathers which the carnivorous animals return, and that quantity of fæcal matter which is discharged by the intestines; having frequently experienced that a sense of fulness removes hunger, and observed persons as it were by instinct pressing on the empty stomach with their hand—we began to suspect that the swallowing of sand, and a number of other indigestible substances, might not be to nourish but to prevent some cravings of the stomach, and that these cravings were in part occasioned by a deficiency of the usual pressure which it receives from the neighbouring parts. In this opinion we were more confirmed, by hearing it was customary among some of the tribes of the north of Asia to repel or mitigate the attacks of hunger by placing a board over the region which is called epigastric, and compressing it gradually by means of cords as the stomach collapses; and by learning afterwards, on a further inquiry, that a similar practice, and from similar motives, was likewise common with some individuals in this country; who, to alleviate the sensation of hunger, straiten the epigastric region with their handkerchief. This practice, however, being often impossible with the brute kind, instead of bringing the neighbouring parts to press on the stomach, they are obliged to distend the stomach, and to bring it to press on the neighbouring parts. Of the two ways of producing this pressure, the last is certainly the most natural. Senebier has supposed that distension of the stomach is the cause of the secretion of the gastric liquor; but how well or ill his opinion may be founded, daily experience permits not a doubt, that, in order to satisfy the calls of hunger, the stomach requires not only to be nourished, but to be filled, or at least to have something like a sense

sense of fulness; and this may probably be one reason for those balls which are found in the stomachs of the chamois, which likewise swallow sand, and in the stomachs of the cow, the sheep, and of the horse, "when they pass away the winter in snowy mountains, where they can find no grais."

From this general view of the food, the natural transition is to those organs by which it is prepared. As all plants are fed on nothing grosser than liquids, we see the reason, why they are all nourished by absorbents, and why, instead of one common alimentary canal, they are furnished with a number of capillary vessels, which by their action assist the living power in moving the fluids along the trunk, the branches, and the leaves. These fluids are observed to move between the different ligneous circles, and the more copiously as the wood is younger or the nearer the circles are to the bark. In the circles themselves, it has been remarked that the sap vessels, from being empty during a great part of the growing season, have been called air vessels; that they are formed of spiral fibres, adapted to some peristaltic motion: and it is plain, that by this structure they are well fitted to propel their contents, whether water or air, upwards or downwards, backwards or forwards, according to the different positions of the plant.

Besides the particular action of the vessels, a general concussion is received from the movement of the waters or winds, which serves as an exercise; a general dilatation is occasioned by both moisture and heat; and a general contraction by dryness and cold, which produce a motion something similar to that of the thorax.

In the spring-season the sap ascends through the empty vessels before the leaves begin to appear. When the vessels are filled through their whole extent, the buds swell, the leaves spread, and the flowers blow; the evaporation from the surface is increased; the sap is diminished by the absorption; the succiferous vessels now cease to bleed; and, the roots being unable to supply the waste, the rains and the dews enter by the trunk, the branches, the leaves, and the petals of the flowers. When the evacuations are immoderately increased by excessive heat, or preternaturally obstructed by the plucking of the leaves, by too much humidity, or other causes which prevent perspiration, the plant soon either sickens or dies. The chyle, which is formed in the sap vessels, has generally something of a saccharine taste.

Considering the forms of animal food, we may naturally expect in the animal kingdom a greater variety of those organs employed in digestion. Most animals have indeed, like the vegetable, both inhaling and exhaling vessels, by which some of their fluids are absorbed, and evacuations regularly carried on. Except, however, in those animals which subsist by liquids, these vessels are of little importance in receiving food or ejecting what is fecal from the system. In these animals the absorbents terminate in a hollow viscus, which is called the alimentary canal, where the fluids undergo a preparatory change, and are partly re-absorbed for assimilation. In all others the food enters by a proboscis, or by an aperture which is called the *mouth*; this mouth is properly the entrance of the alimentary duct. It is very generally furnished with a tongue, which is usually assisting in deglutition; and if the food be of that nature to require cutting, tearing, or grinding, it is likewise furnished with the proper instruments

CURIOSITIES AND RARITIES

ments for these operations. When the food is testaceous, or some hard vegetable substance, and these instruments not in the mouth, something similar may generally be expected in a more remote part of the canal. The crab and the lobster have accordingly grinding-teeth in their stomach, and granivorous fowls have a powerful gizzard lined with a thick corneous substance. It possesses the compressing force of the jaws; and small pebbles which the animals swallow serve it for teeth.

Besides mere trituration or grinding, the solid food will often require to be mixed with some additional liquid. In those carnivorous animals which chew, this liquid during the time of mastication flows into the mouth from certain glands placed in the neighbourhood. In some species of the ape kind a previous dilution takes place in two pouches situated on the sides of the lower jaw. In granivorous birds this dilution is very usually performed in a sac, which is a dilatation of the canal; and the food, being macerated there by the glands or exhaling vessels, gradually passes down, as is needed, to be trituated and farther prepared in the stomach. In the ruminating kind the dilution is performed in a similar manner: but, these having no muscular stomach fitted for grinding, instead of descending the food is brought up again into the mouth, and is then after the proper mastication sent to the stomach. If the food require no mastication, it is sent directly that way at first: a circumstance which shews a curious discernment with respect to foods, and proves that their alimentary canal is subject to the action of voluntary muscles as far as the stomach. Some of those birds which have a diluting sac or ingluvies seem likewise to ruminate. This in the parrot was observed by the gentlemen of the French academy. It has since been observed in rooks, macaws, cockatoos, and others: and Mr. Hunter, to whom physiology is so much indebted, discovered, that the male and the female pigeon secrete in their ingluvies a certain liquor for feeding their young; and that most kinds of what have been thought ruminating birds, do very often, in expressing their fondness, regurgitate their food. Yet both this and another species of regurgitation, which is very common with those of animals that swallow indigestible substances with their food, should be carefully distinguished from rumination.

To the ruminating kinds the diluting sac is by no means peculiar. The porpoise has one, though it does not ruminate; and many of those animals which have none, as the rat, the hog, and the horse, have a part of the stomach covered with a cuticle, and which must therefore principally serve as a reservoir. The gullets of several fishes and serpents are sacs of this kind. It frequently happens that a part of their prey is projecting from the mouth, while another part fills up the gullet and gradually descends, to be reduced in the solvent below. So very dilatable are the stomachs and gullets of some animals, that serpents have been often seen to swallow whole animals which, prior to the gorging, were larger than themselves; and many polypes, and even some of the louse kind, will, by swallowing food, more than double their own bulk.

Applying *stomach* as a general word to the different ventricles of the canal, we may here observe, that every species of animals which ruminate have two stomachs, or at least two divisions in one; that some have three, as the gazella; and some four, as the cow, the dromedary,

medary, and the sheep: but it must not be supposed that the number of stomachs is any proof of a ruminating power. It was said already that the porpoise has two; the porcupine has three divisions in one; and the singular cassowar, although it be found to have four stomachs, does not ruminate; nor, although granivorous, is any one of the four a gizzard.

Somewhat different from these expansions which we have been mentioning as existing in the first part of the alimentary canal, is a sort of pouch which hangs from the neck and the lower mandible of several birds, and which, like the two pouches of apes, may be used either to macerate the food or to carry provisions from a distance to their young. The pelican, a native of warm countries, employs this pouch sometimes to carry a quantity of water; and another native of the same countries, we mean the dromedary, was observed to have at the top of the second of the four ventricles a number of square holes, which being the orifices of as many cavities between the membranes which compose the ventricle, reminded the gentlemen of the French academy of those large reservoirs of water which Pliny mentions to be in camels; and for which, according to his story, their guides have opened them sometimes in cases of extreme thirst.

We come now to one of the principal agents in digestion. Independent of the fluids which mingle with the food in the mouth, the gullet, or macerating sac, there is one denominated the *gastric juice*, and which, either by itself or along with others from the aliments or system, acts in some measure as a solvent. It is secreted from large glands at the entrance of the gizzard, from vessels or glands in the coats of the stomach, and perhaps most plentifully near the pylorus: it powerfully resists the putrefactive fermentation; it coagulates milk and the white of an egg; it dissolves food even when inclosed in metallic tubes; and, when life ceases, it acts frequently on the very stomach from which it was secreted. Its taste, its colour, and its solvent powers, are different in different classes of animals. It seems to be modified according to the age, the health, the habit, and the different aliments on which they live. The sick and the child are incapable of digesting the food that is proper for a healthy man. The hawk kind, after loathing bread and throwing it up without any change, can be gradually brought to take it for food; and Gassendi has mentioned a certain lamb which, being fed on bread, cheese, and on flesh, refused afterwards to taste grass. But what is most surprising in the gastric juice is, that it spares all living bodies, as those worms which exist in the stomach, and the stomach itself while it is alive; and it differs otherwise from a chemical solvent, in that it has an assimilating power, and reduces all substances, whether animal or vegetable, on which it acts, to a certain fluid of determinate properties, which is called *chyle*.

Besides the gastric, the food again, after passing through the stomach, is mingled with a greenish saponaceous liquor, which is called *bile*, and which flows either immediately from the liver or from a vesicle into which it had regurgitated as into a blind gut; at the same time nearly it is mingled with another resembling the saliva from the pancreas or sweet-bread; a gland or glands whose place is supplied in a great many fishes by a number of vermicular appendages to the stomach.

In short, from one extremity of the alimentary canal to the other, fluids are perpetually flowing into its cavity from glands, vessels, or organic pores; and the membranes constantly secreting a mucus to protect themselves from the acrimony of their contents. This acrimony must often be considerable near to that end of the canal where the *fæces* are discharged; for as the first part of the canal has generally one or more dilatations which are called *stomachs*, and secretes at least one fluid which is strongly antiseptic, so the last part has generally appendages which are called *cæca*, where the food always remains for some time, and where, from the quantity of animal matter that happens to be mixed with it, it becomes putrescent. The office of the *cæca* is sometimes supplied by the largeness and convolutions of the colon; to which gut the ileum cannot, when it enters laterally, so easily communicate its peristaltic motion. As the stomachs were the receptacles of the food when it entered, the *cæca* are receptacles of the *fæcal* matter before it be discharged. They are of various forms and capacities; they are often larger than the stomach itself; are often composed of proportionally thin and transparent membranes; and from their contents have often a colour somewhat resembling that of the gall-bladder. Their number is different in different animals. Some have but one. The birds which have them have generally two; the bustard has three; and Swammerdam has dissected insects which had four. As some stomachs have a number of folds which hang pendulous within their cavity, and increase their surface, so have often the *cæca* as well as some portions of the canal. The *cæcum* of both the rabbit and the hare is curiously formed. It is large and beautiful; it is rolled up like a cornu ammonis; it has the like outward appearance; and a fold running spirally is observed within. The animals which live on vegetable food have usually the greatest length of the canal, and the greatest number of stomachs and of *cæca*: yet the cassowary, which has no gizzard, has no *cæcum*; and the polype, which is said to be all stomach, is properly speaking rather all *cæcum*.

To see more fully the process of digestion, we must not overlook that general and organic action which takes place through the whole alimentary canal. The power of mastication exerted in the mouth is obvious to all. But the force of some stomachs has till very lately been known to few; we allude here to that of the muscular or gizzard kind: for Abbé Spallanzani has divided stomachs into three sorts; the muscular, the membranous, and the intermediate. The immortal Borelli, who was probably the first that tried the force of the muscular stomachs by throwing into them nuts or filberds, hollow spheres of glass, hollow cubes of lead, small pyramids of wood, and several other very hard substances, supposed that the power exerted by the stomach of the Indian cock was equal to one thousand three hundred and fifty pounds weight. The force of an intermediate stomach cannot be so great, and that of a membranous one must be still less. Each seems to have more of the solvent as it has less of the muscular power. The most membranous are assisted by the action of the neighbouring parts, and expel their contents as readily as the strongest. The muscular sort is either wholly or principally confined to certain kinds of birds and of fishes, as nature has meant that the grain or the shells which they use as food should first be triturated before it be subjected to the gastric juice.

juice. This comminution takes place in their stomach, because it is plain that had bones or muscles, fully equal to all these effects, been placed in the head, the form of the animal must have been altered, or that equilibrium which it preserves in those fluid elements through which it moves must have been overturned.

As to the movements of the alimentary canal, the direction of hairs found in the stomachs, and the balls of hair which are thrown up, would appear to indicate a circular motion. The intestinal part has a motion similar to that of a worm, and is called the *vermicular* or *peristaltic*. Here every portion retains its own motion, although it be separated from the rest by ligatures. The stomach of the polype, the gullets of the ruminating kinds, and the cœca, have this motion in different directions at different times; and that observed in the alimentary canal of a louse is, when viewed through a microscope in the time of action, amazingly rapid; the stimulating causes employed are, the food, the different liquors with which it is mixed, the air, the nerves where they exist, and a portion of heat. Some degree of heat is necessary to every process of digestion both in the animal and vegetable kingdom: what that degree is depends on the nature of the living body; and is various according to its age, its health, its employments, and habits. The ingenious Hunter has mentioned the digestive and generative heats; and those gardeners who are versant in the operations of hot houses, have on their thermometers the swelling, flowering, and the ripening, heats, with a great many others, for the several plants which they mean to raise.

Among the other causes of digestion some authors have ranked fermentation: and it must be allowed, that something similar to the putrefactive fermentation takes place in the cœca and the lower extremity of the intestine, and that the vinous and acetous fermentations but too frequently occur in our stomach when that viscus is morbidly affected.

It may be admitted as an axiom (says Mr. Hunter,) that two processes cannot go on at the same time in the same part of any substance; therefore neither vegetable nor animal substances can undergo their spontaneous changes while digestion is going on in them: a process superior in power to that of fermentation. But, if the digestive power is not perfect, then the vinous and acetous fermentation will take place in the vegetable, and the putrefactive in the food of those animals which live wholly on flesh. The gastric juice therefore preserves vegetables from running into fermentation, and animal substances from putrefaction; not from any antiseptic quality in the juice, but by making them go through another process, prevents the spontaneous change from taking place.

In most stomachs there is an acid, even although the animal has lived upon meat for many weeks: this, however, is not always the case; therefore we must suppose it is only formed occasionally. Whether the stomach has a power of immediately secreting this acid, or first secretes a sugar which afterwards becomes acid, is not easily ascertained: but we should be inclined to suppose from analogy the last to be the case; for animals in health seem to have the power of secreting sugar, as is found in the milk, and sometimes in the urine from disease. The acid prevails sometimes to so great a degree as to become a disease, attended with very disagreeable symptoms; the stomach converting all substances which have a tendency to become

acid into that form: the sugar of vegetables, and even sometimes vinous spirits, turning directly into acid.

To ascertain whether there is an acid naturally in the stomach, it will be proper to examine the contents before the birth, when the digestive organs are perfect, and when no acid can have been produced by disease or any that has been swallowed. In the sink calf, near the full time, there is acid found in the stomach, although the contents have the same coagulating powers with those of animals who have sucked.

Spallanzani gives the opinion of authors respecting digestion; and so anxious is he to combat the idea of its being fermentation, that he will hardly allow that fermentation ever takes place in the stomach. That fermentation can go on in the stomach, there is no doubt. It is often found that milk, vegetables of all kinds, wine, and whatever has sugar in its composition, become much sooner sour in some stomachs than they would if left to undergo a spontaneous change out of the body; and even spirits in certain stomachs almost immediately degenerate into a very strong acid. All oily substances, particularly butter, very soon become rancid after being taken into the stomach; and this rancidity is the effect of the first process of the fermentation of oil. Mr. Sieffert has been able to restore rancid oils to their original sweetness, by adding to them their due quantity of fixed air; the loss of which may be considered as the first process in this fermentation, similar to what happens in the fermentation of animal and vegetable substances.

Much of the history of living bodies relates to the different degrees of heat, the varieties of soil, and the kinds of food concerned in digestion. The plants grow where the soil and heat are congenial to their nature; and those which admit of the greatest variety with respect to soil, and the largest range on the scale of heat, are the farthest dispersed over the globe. As every soil has usually some regular supply of moisture, the plants that can live upon that supply extend their roots under the surface where their liquid food is the least exposed to evaporation, and, meeting there with the constant nourishment which they require, they remain in that situation for life. If their trunks be so feeble as to need a support, they creep on the ground, they climb the face of a neighbouring rock, or cling to the body of some of the statelier children of the forest. Their range for food is extremely limited: it is chiefly confined to the small space which happens to be occupied by their roots and branches; yet, if any uncommon exertion be necessary, the branches will bend, and the leaves turn to drink of the water that is passing by. If the roots be laid bare, they will again plunge into the earth; if a stone or a ditch be thrown in the way, they will move round or will dip downwards, and spread into the soil on the other side: if there they arrive at one that is unfriendly, they will not enter; but if a favourite earth should be near, though not in their direction, they will twist about, advance as they grow, and at last meet it. In all these cases the prop, the water, and soil, must be necessary; they must also be within a very small distance, otherwise the plants cannot perceive them, or will fail in their languid attempts to approach them.

It may be considered as a general fact, that wherever food is liberally supplied for a whole lifetime in one place, the creatures which use it have seldom much locomotive power, or much inclination

tion to exercise it in a long continued and progressive line. The curious insect is therefore observed to deposit its offspring in those places where the prospect of genial warmth and of plenty seem to preclude the future necessity of wandering or research; and when this offspring is about to pass into a new state, and the organs foretel that a change or perhaps a variety of food will soon be required, the appearance either of wings or legs foretells that the power of locomotion is to be increased. Even nobler animals in their fetal state, where they live upon one species of food, and where that is afforded in regular plenty, spread out their roots, adhere to their soil, and become as stationary as the plant itself; and even when that supply is withdrawn, and they are expelled, yet if the state into which they emerge be helpless and feeble, if their organs of digestion have a weak solvent or masticating power, particularly adapted to some easily assimilated food, and if that food be presented either by their parent or nature without their exertion, their power of locomotion is not great, nor is it exercised in wandering afar. It is when the organs of digestion are strong, and the appetite inclines to variety of aliment, that they are disposed and feel themselves able to wander in search of it; and that then they may be ready to move at intervals from place to place, when the enemy comes or the spirit prompts them, nature has directed them to solid food, and has given them a large alimentary canal, with stomachs, with convolutions, and cæca, where they may lay up provisions for a journey; but afraid to entrust them with too much freedom, lest in their excursions they might wander from the places where subsistence is found, there are two appetites, hunger and thirst, which never fail in a state of health to remind them of their duty.

This variety of food, and the manner in which it is affected by climate, are the cause of the many and singular migrations from spot to spot, from country to country, and from sea to sea: they are the cause of a state of torpor in the hedgehog and the bear, and they partly explain the provident foresight of the ant and of the bee. Animals of great locomotive power, in order to provide for themselves and their offspring, remove to a distant country or climate when they see the signs of approaching famine. Those of less locomotive power, and who are incapable of migrating far, as if warned by heaven, lay up a store for the scarcity to come; or, should their food be of that kind as not to be easily preserved for a season, they receive no secret warning to hoard it at the time when it fails, their system becomes susceptible of torpor, and they are enabled to sleep through the storm of trouble and of want. The source of this want is in most instances to be traced to the nature of the plant and insect. The plant which has little heat of its own depends on the sun or some other agent for one of the great causes of digestion. When this agent refuses the necessary heat, the plant must decline; its leaves, its juices, and its fruits, must fail. The insect tribe, which had no other food, or which like the plant could not maintain their vivifying warmth, must likewise submit to the same fate. The various animals which live on either the one or the other, according to their several dispositions and characters, retire to their stores, to their dens of torpor, or migrate to a country to which they are led by unseen guides to share in its abundance. Of these last the rail

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and the swallow are the only two which are sometimes arrested, and which, with the bear, the hedgehog, and the toad, are obliged to remain in the dwellings of torpor, till the genial season of warmth and plenty returns.

A GEOGRAPHICAL DESCRIPTION OF NEW HOLLAND, WITH AN ACCOUNT OF BOTANY-BAY AND PORT JACKSON.

NEW Holland is the largest island in the world, reaching from 10 to 44 deg. S. lat. and between 110 and 154 of E. long. from London. It received its name from having been chiefly explored by Dutch navigators. The land first discovered in those parts was called Eendragt or Concord-Land, from the name of the ship on-board which the discovery was made, in 1616; 24 deg. and 25 deg. south. In 1618, another part of this coast, nearly in 15 deg. south, was discovered by Zeachen, who gave it the name of Arnheim and Diemen; though a different part from what afterwards received the name of Diemen's Land from Tasman, which is the southern extremity, in latitude 43 degrees. In 1687, Dampier, an Englishman, sailed from Timor, and coasted the western parts of New Holland. In 1699, he left England, with a design to explore this country, as the Dutch suppressed whatever discoveries had been made by them. He sailed along the western coast of it, from 28 to 15 degrees. He then returned to Timor: from whence he went out again; examined the isles of Papua; coasted New Guinea; discovered the passage that bears his name; called a great island which forms this passage or strait on the east side, New Britain; and sailed back to Timor along New Guinea. This is the same Dampier who, between 1683 and 1691, sailed round the world by changing his ships. Notwithstanding the attempts of all these navigators, however, the eastern part of this vast tract was totally unknown till Captain Cook made his late voyages; and, by fully exploring that part of the coast, gave his country an undoubted title to the possession of it; which accordingly has since been taken possession of under the name of New South Wales.

Some have disputed whether the title of island can be properly applied to a country of such vast extent, or whether it ought not rather to be denominated a continent; while others have replied, that though the word island, and others similar to it, do indeed signify a tract of land surrounded by sea, yet in the usual acceptation it means only a land of moderate extent surrounded in this manner. Were it otherwise, we might call the whole world an island, as it is every where surrounded by the sea; and in fact, Dionysius Perigetes applies this term to it, with the addition of the word immense, to distinguish it from other islands. The best rule, according to Mr. Stockdale, for determining when a country ought to lose the name of island and begin to be called a continent, is when it begins to lose the advantages of an insular situation. The first and principal of these, is the being capable of an union under one government, and thence deriving a security from all external attacks excepting those by sea; but in countries of great extent, this is not only difficult, but impossible. If we consider, therefore, New Holland as extend-

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ing about a thousand miles every way, we shall find that its claim to be called a continent is undoubted; its length from east to west being about two thousand four hundred English miles, and two thousand three hundred from north to south.

This coast was first explored by Captain Cook in the year 1770; but his stay was too short to examine the nature of the country with the accuracy which he would otherwise have done had he continued longer in it. In general, it was found rather barren than otherwise. Many brooks and springs were found along the eastern coast, but no river of any consequence. They found only two kinds of trees useful as timber, the pine, and another which produces a sort of gum. They found three kinds of palm-trees; but few esculent plants, though there are abundance of such as might gratify the curiosity of the botanist. A great variety of birds were met with, which have since been particularly described; but the number of quadrupeds bears but a very small proportion to that of the other animals.

This country has now become an object of more consequence than formerly, by reason of the establishment of a British colony in it; where the criminals condemned to be transported are sent to pass their time of servitude. Before this plan was resolved on by government, another had been discussed, viz. that of employing these criminals in workhouses; and Judge Blackstone, with Mr. Eden and Mr. Howard, had considered of the best method of putting it in execution: but, though this plan had been approved by parliament as early as 1779, some difficulties always occurred, which prevented its going forward; and at length, on the 6th of December 1786, orders were issued by his majesty in council for making a settlement on New Holland, establishing a court of judicature in the colony, and other regulations necessary on the occasion. The whole received the complete sanction of legislature in the beginning of the year 1787. The Squadron appointed for putting the design in execution began to assemble at the Mother Bank, the place of rendezvous, in the Isle of Wight, on the 16th of March 1787. It consisted of the *Sirius* frigate, Captain John Hunter; the Supply armed tender, Lieutenant H. L. Ball; three store-ships, the *Golden-grove*, *Fishburn*, and *Borrowdale*, for carrying provisions and stores for two years; and lastly, six transports, the *Scarborough* and *Lady Penrhyn* from Portsmouth, the *Friendship* and *Charlotte* from Plymouth, and the *Prince of Wales* and *Alexander* from Woolwich. These were to carry the convicts, with a detachment of marines in each proportioned to the nature of the service; the largest where resistance was most expected, viz. in those which carried the greatest number of male convicts. On the arrival of Governor Phillip at the station, he hoisted his flag on-board the *Sirius* as commodore of the Squadron; and, the embarkation being completed, he gave the signal to weigh anchor on the 13th of May at day-break. The number of convicts was seven hundred and seventy-eight, of whom five hundred and fifty-eight were men. They touched at the island of *Teneriffe* on the 3d of June, without meeting with any bad accident. Here they staid a week, in order to procure such refreshments as were necessary for preventing the disorders mostly to be dreaded in such a long and perilous voyage. In this they succeeded to their wish; and were about to depart on the 9th of June, when it was discovered that one of the convicts had made his escape, having found means to cut away a boat and make off with it.

it. He offered himself as a sailor aboard a Dutch vessel at that time in the harbour, but was refused; on which he attempted to conceal himself in a cove. In this he would probably have succeeded, had it not been for the boat which he could not conceal; so that he was soon discovered and brought back to the ship, where, however, he obtained his pardon from the governor.

On the 10th of June the fleet set sail from Santa Cruz in the island of Teneriffe, and on the 18th came in sight of the Cape Verd islands, where they steered for St. Jago: but the want of a favourable wind and other circumstances prevented their getting in; so that, as Governor Phillip did not chuse to waste time, they did not touch land till they came to Rio Janeiro on the coast of Brasil. It may seem surprising, that a voyage to the eastward, which of itself may be accounted of sufficient length, should thus be wilfully made so much longer by sailing twice across the Atlantic. The calms, however, so frequent on the coast of Africa, seem of themselves to be a sufficient inducement for navigators to preserve a westerly course; and even the islands at which it is so necessary to touch are not far distant from the American coast. The returning tracks of Captain Cook's three voyages are all within a little space of the 45th degree of west longitude, which is even ten degrees farther west than Cape St. Roque; and that course appears to have been taken voluntarily, without any extraordinary inducement.

During the time of their stay at Santa Cruz the weather had been very moderate; the barometer about thirty inches, and the thermometer never above seventy-two; as they approached the Cape Verd islands it rose to eighty-two, and did not exceed eighty-two degrees fifty-one minutes all the way from thence to Rio Janeiro. Here they met with a very favourable reception, contrary to that which Capt. Cook experienced on a similar occasion. Provisions were so cheap, that, though the allowance of meat was fixed by the governor at twenty ounces per day, the men were victualled completely at 3^d. each, including rice, vegetables, and every other necessary. Wine was not at this time to be had except at an advanced price: but rum was laid in, and such seeds and plants procured as were thought most likely to flourish in New South Wales; particularly coffee, indigo, cotton, and the cochineal fig. An hundred sacks of cassada were likewise purchased as a substitute for bread, if it should happen to be scarce. By the kindness of the viceroy also, some deficiencies in the military stores were made up from the royal arsenal, and every assistance given which the place could afford. They arrived here on the 5th of August 1787, and set sail on the 4th of September, receiving as the last compliment from the governor a salute of twenty-one guns.

From Rio de Janeiro the fleet had a fine run to Table-Bay, in the southern extremity of Africa, which they accomplished in thirty-nine days; where they took in the refreshments meant to supply them during the remainder of the voyage. Here they arrived on the 13th of October; and, having supplied themselves with a great number of live stock, they set sail on the 12th of November, but were long impeded by contrary winds from the south-east. On the 25th they were only eighty leagues distant from the Cape, when Governor Phillip left the *Sirius* and went aboard the *Supply* tender; in hopes, by leaving the convoy, to gain sufficient time for examining the country

country round Botany Bay, that the most proper situation for the new colony might be chosen before the transports should arrive. They now met with favourable winds, blowing generally in very strong gales from the north-west, west, and south-west. The wind shifted only once to the east, but did not continue in that direction above a few hours. On the 3d of January 1788 the Supply came within sight of New South Wales; but the winds then became variable, and a current, which at times set very strongly to the southward, impeded her course so much, that it was not till the 18th of the month that she arrived at Botany Bay.

Governor Phillip no sooner landed than he had an opportunity of conversing with the natives, who were assembled on-shore. As it was the intention of this gentleman to conciliate if possible their friendship, he used every method at this first interview to inspire them with a favourable idea of the Europeans. For this purpose he presented them with beads and other trifling ornaments, which they seemed pleased to wear, though Captain Cook found them very indifferent about any kind of finery he could furnish them with. They seemed, according to the account of that celebrated navigator, to be so attached to their own ornaments, that they made no account of any thing else. They received indeed such things as were given them, but made no offer to return any thing in exchange; nor could they be made to comprehend that any thing of the kind was wanted. Many of the presents which they had received were found afterwards thrown away in the woods.

Governor Phillip, having parted with his new acquaintance in a friendly manner, next set about an examination of the country round Botany Bay, which had been strongly recommended by Capt. Cook as the most eligible place for a settlement. He found, however, that the bay itself was very inconvenient for shipping; being exposed to the easterly winds, and so shallow that ships even of moderate burden could not get far enough within land to be sheltered from the fury of the ocean. Neither did the land about any part of this bay appear an eligible situation for a colony; being in some places entirely swampy, in others quite destitute of water. Point Sutherland seemed to afford the situation most free from objections, but the ships could not approach it; and even here the ground seemed to be universally damp and spongy; so that, on the whole, finding no place within the compass of the bay proper for the new settlement, they found themselves obliged to remove somewhere else.

The rest of the fleet arrived in two days after the Supply; and, that no time might be lost, Governor Phillip ordered the ground about Point Sutherland to be cleared, and preparations to be made for landing, while he went with several officers in three boats to examine Port Jackson, which was only three leagues distant. Here they had the satisfaction to find one of the finest harbours in the world, where one thousand sail of the line might ride in perfect safety. On examining the different coves, one was preferred which had a fine run of spring-water, and where ships could anchor so close to the shore, that at a very small expence quays might be constructed for loading and unloading the largest vessels. This was named by the governor *Sydney Cove*, in honour of Lord Sydney, and the country around it destined for the place of settlement. It is about half a mile long, and a quarter of a mile broad at the entrance.

trance. On the governor's return to Botany Bay, the reports made to him concerning the adjacent country were so exceedingly unfavourable, that orders were immediately given for the removal of the fleet to Port Jackson. On the morning of the 25th, therefore, the governor sailed from Botany Bay, and was soon followed by the whole fleet. In the mean time, they were surprised by the appearance of two other European vessels, which had been first seen off Botany Bay on the 24th. These were found to be two French ships, named the *Astrolabe* and *Bouffola*, which had left France on a voyage of discovery under the command of M. la Peyrouse, in the year 1785. They had touched at the island of Santa Catharina on the coast of Brasil, and from thence gone by the extremity of South America into the Pacific ocean, where they had run along by the coasts of Chili and California; after which they had visited Easter Island, Nootka Sound, Cook's River, Kamtschatka, Manilla, the *Isles des Navigateurs*, Sandwich, and the Friendly Isles. They had also attempted to land on Norfolk Island, but found it impossible on account of the surf. During the whole voyage none were lost by sickness; but two boats crews had unfortunately perished in a surf on the north-west coast of America; and at Masuna, one of the *Isles des Navigateurs*, M. L'Angle, captain of the *Astrolabe*, with twelve of his people, officers and men, were murdered by the savages. This was the more surprising, as there had been an uninterrupted friendship with them from the time the French touched at the island till that unfortunate moment M. L'Angle had gone ashore with two long boats for the purpose of filling some water-casks. His party amounted to forty men; and the natives, from whom the French had already received abundance of refreshments, did not shew any signs of an hostile disposition: but, from whatever motive their resentment was excited, the men had no sooner begun to get out the boats, than the savages made a most furious and unexpected assault with stones. In this encounter M. L'Angle himself, with the people above-mentioned, fell a sacrifice to the treachery of these barbarians. The remainder of the party escaped with great difficulty; the ships having at that time passed a point of land which intercepted their view of the affray.

The convicts and others destined to remain in New South Wales being landed, no time was lost in beginning to clear ground for an encampment, store-houses, &c. The work, however, went on but slowly, partly owing to the natural difficulties they had to encounter, and partly owing to the habitual indolence of the convicts, which indeed was naturally to be expected considering their former way of life. Nevertheless, by the end of the first week of February, the plan of an encampment was formed, and places were marked out for different purposes, so that the colony already began to assume some appearance of order and regularity. The materials and framework of a slight temporary habitation for the governor had been brought out from England ready formed, which were landed and put together with as much expedition as circumstances would allow. Hospital-tents were also erected; and the sickness which soon took place shewed the propriety of so doing. In the passage from the Cape there had been but little sickness, and few of the convicts had died; but a short time after they landed a dysentery began to prevail, which proved fatal in several instances, and the scurvy began to

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rage with great violence, so that the hospital-tents were soon filled with patients. The disorder proved the more virulent as fresh provisions could but rarely be obtained; nor were esculent vegetables often to be had in such plenty as could produce any material alleviation of the complaint: the only remedy for the dysentery was found to be a kind of red gum, produced in plenty by the trees growing upon this coast. The yellow gum has the same properties, though in an inferior degree.

In the beginning of February, a most violent storm of thunder and lightning destroyed five of the sheep which had a shed erected for them under a tree, which proved a prelude to other misfortunes among the cattle. The encampment, however, was carried on with great alacrity; the foundations of the store-houses were laid, and every thing began to wear a promising appearance. On the 7th of the month a regular form of government was established in the colony, with all the solemnity which could possibly be given: the governor made a proper speech to the convicts, reminding them of the situation in which they stood; and that now, if they continued their former practices, it was impossible they could hope for mercy if detected; neither could they expect to escape detection in so small a society. Offenders, therefore, he said, would certainly be punished with the utmost rigour; though such as behaved themselves in a proper manner might always depend upon encouragement. He particularly noticed the illegal intercourse betwixt the sexes, as a practice which encouraged profligacy in every respect; for which reason he recommended marriage: and this exhortation seemed not to be altogether in vain, as fourteen marriages were celebrated that very week in consequence.

Heavy rains took place during the remainder of this month, which shewed the necessity of going on with the work as soon as possible. The want of carpenters, however, prevented this from being done so expeditiously as could have been wished. Only sixteen of these could be hired from all the ships; and no more than twelve of the convicts were of this profession, of whom several were sick; so that the party were by far too few for the work they had to perform. An hundred convicts were added as labourers; but with every effort it was found impossible to complete either the barracks or the huts for the officers as soon as could be wished. On the 14th of February a small party was sent out to settle on Norfolk Island, who have since established a colony there which promises to be of considerable utility. It was soon found, however, absolutely necessary to make examples of some of the convicts at Port Jackson. Towards the end of February it was thought proper to convene a criminal court, in which six of the convicts received sentence of death. One who was the head of the gang was executed the same day; one of the rest was pardoned; the other four were reprieved, and afterwards exiled to a small island within the bay, where they were kept on bread and water. They had frequently robbed both the stores and other convicts. The fellow who was executed, and two others, had been detected in stealing the very day on which they received a week's provision; and at the same time that their allowance was the same as that of the soldiers, spirituous liquors only excepted.

In the beginning of March the governor went out with a small party to examine Broken Bay, lying about eight miles to the north-

ward of Port Jackson. This was found very extensive, with many openings. One of the latter ended in several small branches, and a large lagoon, which they could not at that time examine. Most of the land about the upper part of this branch was low and full of swamps, with great numbers of pelicans, and other aquatic birds. Among the rest they met with an uncommon bird called at that time the *Hooded Gull*, but afterwards found to be the species named by Mr. Latham the *Caspian Tern*.

From this north-west branch they proceeded across the bay to the south-west branch, which is also very extensive, with a second opening to the westward capable of affording shelter to almost any number of ships, with depth of water for vessels of almost any burden. The land was found much higher here than at Port Jackson, more rocky, and equally covered with timber. Large trees were seen growing even on the summits of the mountains, which appeared totally inaccessible to the human species. Round the headland which forms the southern entrance into the bay is a third branch, which Governor Phillip thought the finest piece of water he had ever seen; which for that reason he honoured with the name of *Pit-water*. This branch, as well as the former, is sufficient to contain all the navy of Great Britain; but the latter has a bar at the entrance of only eighteen feet at low water. Within are from seven to fifteen fathoms. The land here is more level than on the south-west branch, and some situations are proper for cultivation. The governor determined to have returned by land, in order to explore the country betwixt Port Jackson and Broken Bay, but the continual rains prevented him.

On the 15th of April, the governor, attended by several officers and a small party of marines, set out on an expedition into the interior parts of the country. Their first landing was at the head of a small cove named *Shell-cove*, near the entrance of the harbour on the north side. Proceeding in this direction, they arrived with great labour at a large lake surrounded on all sides with bog and marshy ground to a considerable extent, and in which they frequently plunged up to the waist. Here they observed that bird so rare in other parts of the world, viz. a black swan. On being fired at, it rose, and shewed that its wings were edged with white, the bill being tinged red. They spent three days in a very laborious manner in passing the marshes and swamps which lie in the neighbourhood of the harbour: and here they had an opportunity of observing, that all the small streams which descend into Port Jackson proceed from swamps, occasioned by the stagnation of the water in the low grounds as it rises from the springs. On leaving these low grounds, they found them succeeded by a rocky and barren country; the hills covered with various flowering shrubs, though frequently inaccessible by reason of various natural obstacles. At about fifteen miles distance from the sea, the governor had a fine view of the internal parts of the country, which were mountainous. To the most northerly chain of these he gave the name of *Carmarthen*, and to the most southerly that of *Lansdown Hills*; and to one which lay between these he gave the name of *Richmond Hill*. It was conjectured, that a large river must rise from these mountains; but there was now a necessity for returning. On the 22d, however, another expedition was undertaken. Governor Phillip with his party landed near the head

head of the harbour. Here they found a good country; but in a short time arrived at a close thicket through which they found it impossible to make their way, so that they were obliged to return. Next day, by keeping close to the banks of a small creek, they made a shift to pass that obstacle, and continued their course for three days to the westward. The country was now extremely fine, either entirely level or rising in small hills, the soil excellent, but stony in a few places. The trees grew at the distance of from twenty to forty feet from each other, in general totally destitute of underwood, which was confined to the barren and stony spots. On the 5th day they saw for the first time in this second expedition Carmarthen and Landf-down hills; but the country all round was so beautiful, that Governor Phillip gave it the name of *Belle-vue*. They were still apparently thirty miles from the mountains which they had intended to reach; but, not having been able to carry more than six days provisions along with them, they found it necessary to return; and even with this small stock the officers as well as men were obliged to carry heavy loads. During all this time they had not proceeded farther in a direct line than thirty miles, so many were the obstructions they had met with from deep ravines, &c. Their return, however, was effected with much greater ease, having cleared a track, and marked trees all the way as they went along to direct them in their journey back. The country explored at this time appeared so fine, that Governor Phillip determined to form a settlement there as soon as a sufficient number could be spared from those works which were immediately necessary. On his return he had the mortification to find, that five ewes and a lamb had been killed very near the camp, and in the middle of the day. This mischief was supposed to have been done by some dogs belonging to the natives.

All this time the scurvy had continued to rage with great violence; so that by the beginning of May near two hundred people were incapable of work. For this reason, and on account of the great difficulty of clearing the ground, no more than eight or ten acres of wheat and barley had been sown, besides what private individuals had sown for themselves; and it was even feared that this small crop would suffer from the depredations of ants and field-mice. To procure as much relief as possible therefore in the present exigence, the Supply was sent in the beginning of May to Lord Howe Island, in hopes of procuring some turtle and other provisions; but unfortunately the vessel returned without any turtle, having met with squally weather, and being obliged to cut away her best bower-anchor. The natives now began to shew an hostile disposition, which they had not hitherto done. One of the convicts, who had wandered away from the rest in quest of vegetables, returned with a very dangerous wound in the back; giving information also, that another who had gone out for the same purpose had been carried off in his fight by the natives, after being wounded in the head. A shirt and hat were afterwards found in some of the huts of the natives, but no intelligence of the man could be gained. This was followed by other misfortunes of the same nature. On the 30th of the month, two men who had been employed in cutting rushes for thatch at some distance from the camp were found dead. One of them had four spears in his body, one of which had pierced quite through it; but the other had no marks of violence about him. In this case, how-

ever,

ever, it was proved, that those who suffered had been the aggressors; as they had been seen with one of the canoes of the natives, which they had taken from one of the fishing places. All possible inquiry was made after the natives who had been guilty of the murder, but to no purpose. In the course of this inquiry, it was found that one of the natives had been murdered, and several wounded, previous to the attack upon the rush-cutters. The governor promised liberty to any convict who should discover the aggressors; but no information was procured, though it is probable that it may prevent accidents of that kind for the future. About this time the two bulls and four cows belonging to government and to the governor, having been left for some time by the man who had the charge of them, strayed into the woods and could not be recovered, though they were afterwards traced to some distance.

The misfortunes which attended those convicts who strayed to too great a distance from the settlement, were not sufficient to prevent some of them from rambling into the woods, in hopes of subsisting themselves there and regaining their liberty. One of these, who had been guilty of a robbery, fled into the woods on the 5th of June, but was obliged to return half starved on the 24th. He had found it impossible to subsist in the woods, and had met with very little relief from the natives. One of them gave him a fish, but made signs for him to go away. According to his account, they themselves were in a very miserable situation; and he pretended to have seen four of them apparently dying of hunger, who made signs to him for something to eat. He pretended also to have fallen in with a party who would have burnt him, and that he made his escape from them with difficulty. He said also, that he had seen the remains of a human body lying on a fire; and endeavoured to inculcate the idea of these savages eating human flesh when other provisions were scarce. This poor wretch was tried and executed for the theft he had committed before his departure, along with another criminal.

By this time the colony was so far advanced, that the plan of a regular town had been marked out. The principal street, when finished, is to be two hundred feet wide, terminated by the governor's house, the main guard, and criminal court. The plans of other streets are likewise marked out; and it is the governor's intention, that, when houses are built here, the grants of land shall be made with such clauses as will prevent the building of more than one house on one allotment, which is to consist of sixty feet in front and one hundred and fifty in depth. Thus a kind of uniformity will be preserved in the building, narrow streets prevented, and many inconveniences avoided, which a rapid increase of inhabitants might otherwise occasion. It has likewise been an object of the governor's attention to place the public buildings in such situations as will be eligible at all times, and particularly to give the storehouses and hospital sufficient space for future enlargement, should it be found necessary. The first huts erected in this place were composed only of the soft wood of the cabbage-palm, in order to give immediate shelter, and which had the further inconvenience of being used quite green. The huts of the convicts were constructed only of upright posts wattled with slight twigs, and plastered up with clay. Buildings of stone might easily have been raised, had there been any means

means of procuring lime for mortar. There were three kinds of stone met with about Sydney Cove, one equal in goodness to Portland stone, an indifferent kind of sand-stone or fire-stone, and a sort which seems to contain iron; but neither chalk nor any species of lime-stone have yet been discovered. Lime was indeed procured from oyster-shells collected in the neighbouring coves to construct a small house for the governor; but it cannot be expected that a sufficient quantity can thus be procured for many or very extensive buildings. Good clay for bricks has been found near Sydney Cove, and very good bricks have been made of it; the wood also, notwithstanding the many reports to the contrary, is found abundantly fit for various purposes after being thoroughly seasoned. Such specimens as have been sent to England were fine-grained and free of knots, but heavy.

On the point of land that forms the west side of the cove a small observatory has been erected, the longitude of which has been ascertained to be $159^{\circ} 19' 30''$ east from Greenwich, and the latitude $32^{\circ} 52' 30''$ south. Instead of thatch they now make use of shingles made from a certain tree, which has the appearance of a fir, but produces wood like English oak.

With regard to the geography of this extensive country, which may perhaps be reckoned a fifth general division of the world, Captains Cook and Furneaux so fully explored its coasts, that succeeding navigators have added nothing to their labours. The only part which still remains unknown is that between the latitude of $37^{\circ} 58'$ and 39° south; and, as none of the fleet which lately sailed from Britain could be supposed to undertake any voyage of discovery, it is unknown whether or not a straight intersects the continent in this place or not. Captain Tench, however, informs us, on the authority of a naval friend, "that, when the fleet was off this part of the coast, a strong set-off shore was plainly felt."

A vast chain of lofty mountains run nearly in a north and south direction farther than the eye can trace, about sixty miles inland. The general face of the country is pleasing, diversified with gentle risings and small winding valleys, covered for the most part with large spreading trees, affording a succession of leaves in all seasons. A variety of flowering shrubs, almost all entirely new to an European, and of exquisite fragrance, abound in those places which are free from trees; and, among these, a tall shrub, bearing an elegant flower, which smells like English may, is peculiarly delightful, and perfumes the air to a great distance. There are but few trees; and, as Captain Tench and others relate, of so bad a grain, that they can scarcely be used for any purpose:—This, however, Mr. Stockdale ascribes to their being used in an unseasoned state, as mentioned before. In return for these bad qualities, however, the trees yield vast quantities of the gum already-mentioned as a cure for the dysentery. It is of an acrid quality, and therefore requires to be given along with opiates. The tree which yields it is of very considerable size, and grows to a great height before it puts out any branches. The gum itself is usually compared to *sanguis draconis*, but differs from it in being perfectly soluble in water. It may be extracted from the wood by tapping, or taken out of the veins when dry. The leaves are narrow, and not unlike those of a willow; the

the wood fine-grained and heavy, but warps to such a degree, when not properly seasoned, as soon to become entirely useless.

The yellow gum is properly a resin, being entirely insoluble in water. It greatly resembles gamboge, but has not the property of staining. It is produced by a low small plant with long grassy leaves; but the fructification shoots out in a surprising manner from the centre of the leaves on a single straight stem to the height of twelve or fourteen feet. This stem is strong and light, and is used by the natives for making their spears. The resin is generally dug up from the soil under the tree, not collected from it, and may perhaps be the same which Tasman calls *gum lac of the ground*. It has been tried by Dr. Blanc, physician to St. Thomas's hospital, who found it very efficacious in the cure of old fluxes, and that in many and obstinate cases. Many of the New Holland plants have been already imported into Britain, and are now flourishing in perfection at the nursery gardens of Mr. Lee of Hammer Smith.

The soil immediately around Sydney Cove is sandy, with here and there a stratum of clay; but hitherto the produce has not been remarkable. The principal difficulty which is experienced in clearing the ground arises from the size of the trees, which is said to be so enormous, that twelve men have been employed for five days in grubbing up one. Captain Cook speaks of some fine meadows about Botany Bay, but none of these have been seen by the present settlers, and Governor Phillip supposes them to have been swamps seen at a distance. Grass grows in almost every place, but in the swamps with the greatest vigour and luxuriancy, though not of the finest quality. It is found to agree better with cows and horses than sheep. A few wild fruits are sometimes procured; among which is a kind of small purple apple mentioned by Captain Cook; and a fruit which has the appearance of a grape, but tasting like a green gooseberry, and excessively sour.

From the first discovery of this continent, the extreme scarcity of fresh water has been mentioned by every navigator. None have been fortunate enough to enter the mouth of any navigable river such as might be expected in a country of such extent. The settlers about Port Jackson found enough for the common purposes of life; but Captain Tench informs us, that when he left the country, towards the end of 1788, there had been no discovery of a stream large enough to turn a mill. Since that time, however, Governor Phillip has been more successful; as we are informed by a letter of his to Lord Sydney, dated Feb. 13, 1790:—In this letter he relates, that, soon after the ships sailed in November 1788, he again made an excursion to Botany Bay, where he staid five days; but the researches he made there tended only to confirm him in the opinion he already entertained, that the country round it was by no means an eligible situation for a colony. After having visited Broken Bay several times with boats, a river was found, which has since been traced, and all those branches explored which afforded any depth of water. This river has obtained the name of Hawkesbury, is from three hundred to eight hundred feet wide, and seems navigable for the largest merchant ships as high as Richmond-hill, at which it becomes very shallow, and divides into two branches; on which account the governor calls Richmond-hill the head of the river. As after very heavy rains, however, the water sometimes rises thirty

feet

feet above its level, it would not be safe for ships to go up so far; but fifteen or twenty miles below it they would lie in fresh water, and be perfectly safe.

The country about Broken Bay is at first high and rocky, but as we proceed up the river it becomes more level, the banks being covered with timber, and the soil a light rich mould, supposed to be very capable of cultivation. The other branches of this river are shallow, but probably run many miles up into the country. Great numbers of black swans and wild-ducks were seen on these rivers, and the natives had several decoys for catching quails.

Richmond-hill, near which a fall prevented the boats from proceeding farther up, is the most southerly of a large range of hills which run to the northward, and probably join the mountains nearly parallel to the coast from fifty to sixty miles inland. The soil of this hill is good, and it lies well for cultivation. There is a very extensive prospect from the top, the whole country around seeming a level covered with timber. There is a flat of six or seven miles between Richmond-hill and a break in the mountains which separates Landstown and Carmarthen hills; in which flat the governor supposes that the Hawkesbury continues its course; though the river could not be seen on account of the timber with which the ground is every where covered where the soil is good. Six miles to the southward of Port Jackson is a small river; and twenty to the westward is one more considerable, which probably empties itself into the Hawkesbury. As far as this river was at that time explored, the breadth was computed at from three hundred to four hundred feet. It was named the Nepaan, and, like the Hawkesbury, sometimes rises thirty feet above its level. A party who crossed the river attempted to reach the mountains, but found it impossible, probably for want of provisions. After the first day's journey they met with such a succession of deep ravines, the sides of which were frequently so inaccessible, that in five days they could not proceed farther than fifteen miles. At the time they turned back, they supposed themselves to be twelve miles from the foot of the mountains. With regard to the state of the colony, it appears from this letter to be as flourishing as could in any reasonable manner be expected. Another has been formed at a place called Rosehill, at the head of the harbour of Sydney Cove. At this place is a creek, which at half-flood has water for large boats to go three miles up; and one mile higher the water is fresh and the soil good. Some ground having been cleared and cultivated, the governor in the above letter writes, that twenty-seven acres were sown with corn, and that in December the crop was got in:—That the corn was exceedingly good; about two hundred bushels of wheat and sixty of barley, with a small quantity of flax, Indian corn, and oats; all which was preserved for seed:—That if settlers are sent out, and the convicts divided amongst them, this settlement will very shortly maintain itself; but without which this country cannot be cultivated to any advantage. The country for twenty miles to the westward is very capable of cultivation; though the labour of cutting down the trees is very great. At Sydney Cove the stores had been infested by a swarm of rats, which destroyed no less than twelve thousand pounds weight of flour and rice. The gardens also had suffered very considerably; so that, having met with such a considerable loss of provision, and a

sufficient supply not being procured from the Cape, Governor Phillip thought proper to send a further detachment to Norfolk Island, where the fertility of the soil afforded great hopes of their being able in a short time to subsist themselves independent of any assistance from the stores.

With regard to the civil establishment in this colony, the powers of the governor are absolutely unlimited, no mention being made of a council to assist him in any thing; and as no stated time is appointed for assembling the courts, similar to the assizes and gaol deliveries in England, the duration of imprisonment is altogether in his hands. The governor is allowed to grant pardons in all cases, treason and wilful murder excepted; and even in these he has authority to stay the execution of the law until the king's pleasure shall be signified. In case of the governor's death, the lieutenant-governor takes his place; and, on his decease, the authority is lodged in the hands of the senior officer.

It was not long after the convicts were landed that there appeared a necessity for assembling a criminal court; and it was accordingly convened by warrant from the governor. The members were the judge-advocate, who presided, three naval and three marine officers. The number of members is limited by act of parliament to seven; who are expressly ordered to be officers either of his majesty's sea or land forces. The court being met, completely arrayed and armed as at a military tribunal, the judge-advocate proceeds to administer the usual oaths taken by the jurymen in England to each member; one of whom afterwards swears him in a like manner. This ceremony being over, the crime is laid to the prisoner's charge, and the question "guilty or not guilty" put to him. No law officer being appointed on the part of the crown, the party at whose suit he is tried is left to prosecute the prisoner entirely by himself. All the witnesses are examined on oath; and the decision must be given according to the laws of England, or "as nearly as may be, allowing for the circumstances and situation of the settlement," by a majority of votes, beginning with the youngest member, and ending with the president of the court. No verdict, however, can be given in cases of a capital nature, unless at least five of the seven members concur therein. The evidence on both sides being finished, and the prisoner's defence heard, the court is cleared, and, on the judgment being settled, is thrown open again, and sentence pronounced. During the time of sitting, the place in which it is assembled is directed to be surrounded by a guard under arms, and admission granted to every one who chuses to enter it.—The annual expence of the civil and military establishments of this colony is about ten thousand pounds.

The quadrupeds on the continent of New Holland hitherto discovered are principally of the opossum kind, of which the most remarkable is the kangaroo. There is also a species of dogs very different from those known in Europe. They are extremely fierce, and never can be brought to the same degree of familiarity with those we are acquainted with. Some of them have been brought to England, but still retain their usual ferocity. There are a great many beautiful birds of various kinds; among which the principal are the black swans already-mentioned, and the ostrich or cassowary; which last arrives frequently at the height of seven feet or more. Several kinds

kinds of serpents, large spiders, and scolopondras, have also been met with. There are likewise many curious fishes; though the finny tribe seem not to be so plentiful on the coast as to give any considerable assistance in the way of provisions for the colony. Some very large sharks have been seen in Port Jackson, and two smaller species, one named the Port Jackson shark, the other Watts's shark. The latter, notwithstanding its diminutive size, the mouth scarcely exceeding an inch in breadth, is excessively voracious. One of them, having been taken and flung down upon the deck, lay there quiet for two hours; after which, Mr. Watts's dog happening to pass by, the fish sprung upon it with all the ferocity imaginable, and seized it by the leg in such a manner that the animal could not disengage himself without assistance.

The climate of this continent appears not to be disagreeable, notwithstanding the violent complaints which some have made about it. The heat has never been excessive in summer, nor is the cold intolerable in winter. Storms of thunder and lightning are frequent; but these are common to all warm countries; and it has been supposed (though upon what foundation does not well appear) that were the country cleared of wood, and inhabited, these would in a great measure cease. A shock of an earthquake has likewise been felt; but these natural calamities are incident to some of the finest countries in the world. It is not known whether there are any volcanoes or not.

The natives of New Holland appear extremely deficient in the useful arts. Of the cultivation of the ground they have no notion; nor can they even be prevailed upon to eat bread or dressed meat. Hence they depend entirely for subsistence on the fruits and roots they can gather, with the fish they catch. Governor Phillip also mentions their frequent setting fire to the grass, in order to drive out the opossums and other animals from their retreats. As all these resources, however, must be at best precarious, it is no wonder that they are frequently distressed for provisions. Thus, in the summer-time they would eat neither the shark nor sting-ray; but in winter any thing was acceptable. A young whale, being driven ashore, was quickly cut in pieces and carried off; they broiled it only long enough to scorch the outside; and in this raw state they eat all their fish. They broil also the fern-root, and another whose species is unknown. Among the fruits used by them is a kind of wild fig; and they eat also the kernels of a fruit resembling the pine-apple. The principal part of their subsistence, however, is fish; and, when these happened to be scarce, they were wont to watch the opportunity when the colonists hauled the seine, and often seized the whole, though a part had formerly been offered or given them. They sometimes strike the fish from the canoes with their spears, sometimes catch them with hooks, and also make use of nets, contrary to the assertion of Dr. Hawke's worth, who says that none of these are to be met with among them. Their nets are generally made of the fibres of the flax-plant, with very little preparation, and are strong and heavy; the lines of which they are composed are twisted like whip-cord. Some of them, however, appear to be made of the fur of an animal, and others of cotton. The meshes of their nets are made of very large loops artificially inserted into each other, but without any knots. Their hooks are made of the inside of a shell very much resembling mother-of-pearl. The canoes in which they fish are nothing more than large

pieces of bark tied up at both ends with vines; and, considering the slight texture of these vessels, we cannot but admire the dexterity with which they are managed, and the boldness with which they venture in them out to sea. They generally carry fire along with them in these canoes, to dress their fish when caught. When fishing with the hook, if the fish appears too strong to be drawn ashore by the line, the canoe is paddled to the shore; and, while one man gently draws the fish along, another stands ready to strike it with a spear, in which he generally succeeds. There is no good reason for supposing them to be cannibals, but they never eat animal substances but raw or next to it. Some of their vegetables are poisonous when raw, but deprived of this property when boiled. A convict unhappily experienced this by eating them in an unprepared state; in consequence of which he died in twenty-four hours. The dislike of the New Hollanders to the European provisions has already been mentioned: if bread be given them, they chew and spit it out again, seldom choosing to swallow it. They like salt beef and pork rather better; but they could never be brought to taste spirits a second time.

The huts of these savages are formed in the most rude and barbarous manner that can be imagined. They consist only of pieces of bark laid together in the form of an oven, open at one end, and very low, though long enough for a man to lie at full length. There is reason, however, to believe, that they depend less on them for shelter than on the caverns with which the rocks abound. They go invariably naked, as has already been observed; though we must not imagine that the custom of going naked injures them so to the climate as to make them insensible to the injuries of the weather. The colonists had repeated opportunities of observing this, by seeing them shivering with cold in the winter-time, or huddling together in heaps in their huts or in caverns, till a fire could be kindled to warm them. It is probable, however, notwithstanding their extreme barbarity, that some knowledge of the arts will soon be introduced among them, as some have been seen attentively considering the utensils and conveniences of the Europeans, with a view, seemingly, of making similar improvements of their own. It has also been observed, that in some things they possess a very great power of imitation. They can imitate the songs and language of the Europeans almost instantaneously, much better than the latter can imitate theirs by long practice. Their talent for imitation is also discernible in their sculptures representing men and other animals every where met with on the rocks; which, though rude, are very surprising for people who have not the knowledge even of constructing habitations in the least comfortable for themselves, or even clothes to preserve them from the cold.

In their persons, the New Hollanders are active, vigorous, and stout, though generally lean. Dampier asserts that they have a dimness of sight; though later navigators have determined this to be a mistake, ascribing to them, on the contrary, a quick and piercing sight. Their sense of smelling is also very acute: one of them, having touched a piece of pork, held out his finger for his companion to smell, with strong marks of disgust. The only kind of food they eagerly accept of is fish. Their behaviour with regard to the women has been hitherto unaccountable to the colonists. Few of them, comparatively speaking, have been seen; and these have sometimes kept

kept back with the most jealous sensibility ; sometimes offered with the greatest familiarity. Such of the females as have been seen have soft and pleasing voices ; and, notwithstanding their barbarism and excessive rudeness, seem not to be entirely destitute of modesty.

The New Hollanders generally display great personal bravery on the appearance of any danger. An old man, whom Governor Phillip had treated with some familiarity, took occasion to steal a spade ; but, being taken in the fact, the governor gave him a few slight slaps on the shoulder ; on which the old man caught hold of a spear, and, coming up to him, seemed for some time determined to strike, though had he done so it would have been impossible for him to escape, being then surrounded by the officers and soldiers. No encounters between parties of the natives themselves have been observed, though from some circumstances it appears that wars are carried on among them. They have more than once been seen assembled as if bent on some expedition. An officer one day met fourteen of them marching along in a regular Indian file through the woods, each man having a spear in one hand and a stone in the other. A chief appeared at their head, who was distinguished from the rest by being painted. They passed on peaceably, though greatly superior in number to our people. On another occasion they offered no hostilities when assembled to the number of two or three hundred, and meeting the governor attended only by a small party. With all their courage, however, they are much afraid of a musket, and almost equally so of a red coat, which they know to be the martial dress of the Europeans. The mischief which they have hitherto done has been exercised only on some straggling convicts, most of whom probably have been the first aggressors.

Though these savages allow their beards to grow to a considerable length, it does not appear that they look upon them to be any ornament, but rather the contrary, as appears from the following instance. Some young gentlemen belonging to the *Sirius* one day met an old man in the woods with a beard of considerable length. This his new acquaintance let him know that they would rid him of, stroaking their chins, and shewing him the smoothness of them at the same time. At length the old fellow consented ; and one of the youngsters taking a penknife from his pocket, and making the best substitute for lather he could, performed the operation with such success that the Indian seemed highly delighted. In a few days he paddled alongside of the *Sirius* again, pointing to his beard ; but could not by any means be prevailed upon to enter the ship. On this a barber was sent down to him, who again freed him from his beard, at which he expressed the utmost satisfaction. It has, however, been found impossible to form any kind of permanent intercourse with the natives, though many attempts have been made for that purpose. At first the colonists imagined the spears of the New Hollanders to be very trivial weapons ; but it now appears that they are capable of inflicting very grievous and mortal wounds. They are sometimes pointed with a sharp piece of the same reed of which the shafts are made, but more frequently with the sharp bone of the sting-ray. They certainly burn their dead ; which perhaps has given rise to the report of their being cannibals. Governor Phillip, observing the ground to be raised in several places, caused one of these tumuli to be opened, in which were found a jaw-bone half consumed

consumed and some ashes. From the manner in which the ashes were deposited, it appears that the body had been laid at length, raised from the ground a little space, and consumed in that posture; being afterwards lightly covered with mould.

The only domestic animals they have are the dogs already-mentioned, which resemble the fox-dog of England. In their language these animals are called *dingo*; but all other quadrupeds without exception they name *kangaroo*.—They seem very little given to thieving in comparison with the inhabitants of most of the South Sea islands; and are very honest among themselves, leaving their spears and other implements open on the beach, in full and perfect security of their remaining untouched. They are very expert at throwing their javelins, and will hit a mark with great certainty at a considerable distance; and it seems that sometimes they kill the kangaroo with this weapon, as a long splinter of one of the spears was taken out of the thigh of one of these animals, the flesh having closed over it completely. The people are more numerous than was at first imagined, though still the number of inhabitants must be accounted few in comparison to the extent of country; and there is great reason to believe that the interior parts are uninhabited.

The New Hollanders bake their provisions by the help of hot stones, like the inhabitants of the South Sea islands. They produce fire with great facility according to Captain Cook, but with difficulty according to later accounts, and spread it in a wonderful manner. To produce it, they take two pieces of dry soft wood; one is a stick about eight or nine inches long, the other piece is flat. The stick they shape into an obtuse point at one end; and, pressing it upon the other, turn it nimbly, by holding it between both their hands, as we do a chocolate-mill; often shifting their hands up, and then moving them down upon it, to increase the pressure as much as possible. By this method they get fire in less than two minutes, and from the smallest spark they increase it with great speed and dexterity. "We have often seen (says Captain Cook) one of them run along the shore, to all appearance with nothing in his hand, who stooping down for a moment, at the distance of every fifty or an hundred yards, left fire behind him, as we could see, first by the smoke, and then by the flame along the drift of wood and other litter which was scattered along the place. We had the curiosity to examine one of these planters of fire when he set off, and we saw him wrap up a small spark in dry grass, which, when he had run a little way, having been fanned by the air that his motion produced, began to blaze; he then laid it down in a place convenient for his purpose, inclosing a spark of it in another quantity of grass, and so continued his course."

ORIGIN AND HISTORY OF GLOVES.

TO proceed regularly, we must first enquire into the antiquity of this part of dress; and secondly, shew its various uses in the several ages of the world.

Some have given them a very early original, imagining they are noticed in the 108th Psalm, where the royal prophet declares, he will cast his shoe over Edom. They go still higher; supposing them to be used in the times of the Judges, Ruth iv. 7. where it is said, it was the custom for a man to take off his shoe, and give it to his neighbour,

neighbour, as a token of redeeming or exchanging any thing. They tell us, the word which in these two texts is usually translated shoe is by the Chaldee paraphrast in the latter rendered glove. Casaubon is of opinion that gloves were worn by the Chaldeans, because the word here mentioned is in the Talmud Lexicon explained—the clothing of the hand. But it must be confessed, all these are mere conjectures; and the Chaldean paraphrast has taken an unallowable liberty in his version.

Let us, then, be content to begin with the authority of Xenophon. He gives a clear and distinct account of gloves. Speaking of the manners of the Persians, he gives us a proof of their effeminacy; that, not satisfied with covering their head and their feet, they also guarded their hands against the cold with thick gloves. Homer, speaking of Laertes at work in his garden, represents him with gloves on his hands, to secure them from the thorns. Varro, an ancient writer, is an evidence in favour of their antiquity among the Romans. In lib. ii. cap. 55. *de Re Rustica*, he says, that olives gathered by the naked hand are preferable to those gathered with gloves. Athenæus speaks of a celebrated glutton, who always came to table with gloves on his hands, that he might be able to handle and eat the meat while hot, and devour more than the rest of the company.

These authorities shew, that the ancients were not strangers to gloves; though, perhaps, their use might not be so common as amongst us. When the ancient severity of manners declined, the use of gloves prevailed among the Romans; but not without some opposition from the philosophers. Musonius, a philosopher, who lived at the close of the first century of Christianity, among other invectives against the corruption of the age, says, "It is a shame, that persons in perfect health should clothe their hands and feet with soft and hairy coverings." Their convenience, however, soon made their use general. Pliny the younger informs us, in his account of his uncle's journey to Vesuvius, that his secretary sat by him, ready to write down whatever occurred remarkable; and that he had gloves on his hands, that the coldness of the weather might not impede his business.

In the beginning of the ninth century, the use of gloves was become so universal, that even the church thought a regulation in that part of dress necessary. In the reign of Louis le Debonnaire, the council of Aix ordered, that the monks should only wear gloves made of sheep-skin.

That time has made alteration in the form of this, as in all other apparel, appears from the old pictures and monuments.

Let us now proceed to point out the various uses of gloves in the several ages; for, beside their original design for a covering of the hand, they have been employed on several great and solemn occasions: as in the ceremony of investitures, in bestowing lands; or in conferring dignities. Giving possession by the delivery of a glove, prevailed in several parts of Christendom in later ages. In the year 1002, the bishops of Paderborn and Moncerco were put into possession of their sees by receiving a glove. It was thought so essential a part of the episcopal habit, that some abbots in France, presuming to wear gloves, the council of Poitiers interposed in the affair, and forbade them the use of them, on the same footing with the ring and sandals, as being peculiar to bishops.

Monfieur

Monsieur Favin observes, that the custom of blessing gloves at the coronation of the kings of France, is a remain of the eastern practice of investiture by a glove. A remarkable instance of this ceremony is recorded in the German History. The unfortunate Conradin was deprived of his crown and his life by the usurper Mainfroy. When, having ascended the scaffold, the injured prince lamented his hard fate, he asserted his right to the crown; and, as a token of investiture, threw his glove among the crowd, begging it might be conveyed to some of his relations, who should revenge his death. It was taken up by a knight, who brought it to Peter king of Arragon, who was afterwards crowned at Palermo.

As the delivery of gloves was once a part of the ceremony used in giving possession, so the depriving a person of them was a mark of divesting him of his office, and of degrading him. Andrew Herkley earl of Carlisle was, in the reign of Edward II. impeached of holding a correspondence with the Scots, and condemned to die as a traitor. Walsingham, relating other circumstances of his degradation, says—"His spurs were cut off with a hatchet; and his gloves and shoes were taken off, &c."

Another use of gloves was in a duel: on which occasion, he who threw down the glove was thereby understood to give defiance; and he who took it up to accept the challenge.

The use of single combat, at first designed only for a trial of innocence, like the ordeal of fire and water, was in succeeding ages practised for deciding right and property. Challenging by the glove was continued down to the reign of Queen Elizabeth, as appears by an account given by Spelman, of a duel appointed to be fought in Tothill Fields, in the year 1571. The dispute was concerning some lands in the county of Kent. The plaintiffs appeared in court, and demanded a single combat. One of them threw down his glove, which the other immediately took up, carried off on the point of his sword, and the day of fighting was appointed; but the matter was adjusted in an amicable manner by the queen's judicious interference.

Though such combats are now no longer in use, we have one ceremony still remaining among us, in which the challenge is given by a glove, viz. at the coronation of the kings of England: upon which occasion, his majesty's champion, completely armed, and well mounted, enters Westminster-hall, and proclaims that, if any man shall deny the prince's title to the crown, he is ready to maintain and defend it by single combat. After which declaration he throws down his glove, or gauntlet, as a token of defiance.

This custom of challenging by the glove is still in use in several parts of the world. It is common in Germany, on receiving an affront, to send a glove to the offending party, as a challenge to a duel.

The last use of gloves to be mentioned here was for carrying the hawk, which is very ancient. In former times, princes and other great men took so much pleasure in carrying the hawk on their hand, that some of them have chosen to be represented in this attitude. There is a monument of Philip I. of France still remaining; on which he is represented at length, on his tomb, holding a glove in his hand.

Mr. Chambers says, that formerly judges were forbidden to wear gloves on the bench. No reason is assigned for this prohibition.

Our

Our judges lie under no such restraint; for both they and the rest of the court make no difficulty in receiving gloves from the sheriffs, whenever the session or assize concludes without any one receiving sentence of death, which is called a *maiden assize*. This custom is of great antiquity.

Our curious antiquarian has also preserved a very singular anecdote concerning gloves. Chambers informs us, that it is not safe at present to enter the stables of princes without pulling off the gloves. He does not, indeed, tell us in what the danger consists. A friend from Germany explains the matter. He says, that it is an ancient established custom in that country, that whoever enters the stables of a prince, or great man, with his gloves on his hands, is obliged to forfeit them, or redeem them by a fee to the servants. The same custom is observed in some places at the death of the stag; in which case the gloves, if not taken off, are redeemed by money given to the huntsmen and keepers. This is practised in France; and the late king never failed of pulling off one of his gloves on that occasion. The reason of this ceremony is not known.

We meet with the term *glove-money* in our old records; by which is meant, money given to servants to buy gloves. This, no doubt, gave rise to the saying of *giving a pair of gloves*, to signify making a present for some favour or service.

To the honour of the glove, it has more than once been admitted as a term of the tenure of holding lands. One Bortran, who came in with William the Conqueror, held the manor of Farnham Royal by the service of providing a glove for the king's right hand on the day of his coronation, and supporting the same hand that day while the king held the royal sceptre. In the year 1177, Simon de Mertin gave a grant of his lands in consideration of fifteen shillings, one pair of white gloves at Easter, and a pound of cummin.

ACCOUNT OF THE WONDERFUL PROPERTIES OF THE POLYPUS.

THE polypus is a species of fresh-water insects, belonging to the genus of hydra, of the order of zoophytes, and class of vermes. The name of hydra was given them by Linnæus on account of the property they have of reproducing themselves when cut in pieces, every part soon becoming a perfect animal. Dr. Hill called them *biota*, on account of the strong principle of life with which every part of them is endowed.

These animals were first discovered by Lewenhoeck, who gave some account of them in the Philosophical Transactions for 1703; but their wonderful properties were not thoroughly known till the year 1740, when Mr. Trembley began to investigate them. Previous to his discoveries, indeed, Leibnitz and Boerhaave, by reasonings *à priori*, had concluded that animals might be found which would propagate by slips like plants; and their conjectures were soon verified by the observations of the gentleman above-mentioned. At first, however, Mr. Trembley was uncertain whether he should reckon these creatures animals or plants; and, while thus uncertain, he wrote a letter on the subject to Mr. Bonnet in January 1741; but in March the same year he had satisfied himself that they were real animals.

The surprise of Mr. Trembley, and of others, on discovering the true nature of these animals, was very great. When Mr. Reaumur saw for the first time two polypes formed from one which he had divided into two parts, he could hardly believe his own eyes; and even after having repeated the operation an hundred times, he said that the sight was by no means familiar to him. On the 18th of July 1741, M. Buffon wrote to Martin Folkes, Esq. president of the Royal Society, acquainting him with "the discovery of a small insect called a *polypus*, which is found about the common duck-weed; and which, being cut in two, puts from the upper part a tail, and from the lower end a head, so as to become two animals instead of one. If it be cut into three parts, the middlemost also puts out from one end a head, and from the other a tail, so as to become three distinct animals, all living like the first, and performing the various offices of their species."—In September the same year, a letter was communicated from C. Beatinck, Esq. at the Hague, describing the insects discovered by Mr. Trembley, adding, that he himself had seen them; and in November that year, a letter was read before the society from Gronovius at Leyden, giving an account of a water-insect, which, says he, if cut into five or six pieces, in a few hours there will be as many animals exactly similar to their parent. These accounts, however, were all deemed so extraordinary, that they were not credited, until professors Albinus and Muschenbroek provided themselves with them, and found every thing related concerning them to be exactly true. In March 1742, Mr. Folkes gave an account of them to the Royal Society, from some observations made on several polypes which Mr. Trembley had sent from Holland. They were soon after found in England, and the observations made upon them were published by several persons; so that no doubt remained concerning the reality of what had been related concerning them.

The general character of the polype is, that it fixes itself by its base; is gelatinous, linear, naked, contractile; and can change its place. The mouth, which is placed at one end, is surrounded by hair-like feelers. The young ones grow out from its sides; but in autumn it produces eggs from its sides. There are six varieties.

1. The *viridis*, or green polype, has commonly ten short arms.
2. The *fusca* has frequently eight arms several times longer than the body.
3. The *grisea* is of a yellowish colour, small towards the bottom, and has long arms, generally about seven in number.
4. The *pallens* has generally about six arms of a moderate length.
5. The *hydatula* has a vesicular body, and four obsolete arms. It is found in the abdomen of sheep, swine, &c.
6. The *stentorea* has been called the *tunnel-shaped*, and has a mouth surrounded with a row of hairs.
7. The *socialis* is bearded, thick, and wrinkled.

The three first species are those on which the greatest number of experiments have been made; and their shapes are so various, that it is by no means easy to describe them. They are generally found in ditches. Whoever has carefully examined these when the sun is very powerful, will find many little transparent lumps of the appearance of a jelly, and size of a pea, and flattened upon one side. The same kind of substances are likewise to be met with on the under side of the leaves of plants which grow in such places. These are the polypes

lypes

types in a quiescent state, and apparently inanimate. They are generally fixed by one end to some solid substance, with a large opening, which is the mouth, at the other; having several arms fixed round it, projecting as rays from the centre. They are slender, pellucid, and formed of a tender substance like the horns of a snail, and capable of contracting themselves into a very small compass, or of extending to a considerable length. The arms are capable of the same contraction and expansion as the body; and with these they lay hold of minute worms and other insects, bringing them to the mouth and swallowing them; the indigestible parts are again thrown out by the mouth.

The green polype was that first discovered by Mr. Trembley; and the first appearances of spontaneous motion were perceived in its arms, which it can contract, extend, and twist about, in various directions. On the first appearance of danger they contract to such a degree that they appear little bigger than a grain of sand, of a fine green colour, the arms disappearing entirely. Soon after he found the grisea, and afterwards the fusca.

The bodies of the viridis and grisea diminish almost insensibly from the anterior to the posterior extremity; but the fusca is for the most part of an equal size for two-thirds of its length from the anterior to the posterior extremity, from which it becomes abruptly smaller, and then continues of a regular size to the end. These three kinds have at least six, and at most twelve or thirteen, arms; though sometimes the grisea is met with having eighteen arms. They can contract themselves till their bodies do not exceed one-tenth of an inch in length, and they can stop at any intermediate degree of contraction or extension. They are of various sizes, from half an inch to an inch and a half long; their arms are seldom longer than their bodies, though some have them an inch, and some even eight inches, long. The thickness of their bodies decreases as they extend themselves, and *vice versa*; and they may be made to contract themselves either by agitating the water in which they are contained, or by touching the animals themselves. When taken out of the water, they all contract so much that they appear only like a little lump of jelly. The arms have the same power of contraction or expansion that the body has; and they can contract or expand one arm or any number of arms, independent of the rest; and they can likewise bend their bodies or arms in all possible directions. They can also dilate or contract their bodies in various places, and sometimes appear thick set with folds, which, when carelessly viewed, appear like rings. Their progressive motion is performed by that power which they have of contracting and dilating their bodies. When about to move, they bend down their head and arms, lay hold by means of them on some other substance to which they design to fasten themselves; then they loosen their tail, and draw it towards the head; then either fix it in that place, or stretching forward their head as before, repeat the same operation. They ascend or descend at pleasure in this manner upon aquatic plants, or upon the sides of the vessel in which they are kept; they sometimes hang by the tail from the surface of the water, or sometimes by one of the arms; and they can walk with ease upon the surface of the water. On examining the tail with a microscope, a small part of it will be found to be dry above the surface of the water, and as it were in a little concave space of which the tail forms the

bottom; so that it seems to be suspended on the surface of the water, on the same principle that a small pin or needle is made to swim. When a polype, therefore, means to pass from the sides of the glass to the surface of the water, it has only to put that part out of the water by which it is to be supported, and to give it time to dry, which it always does upon these occasions; and they attach themselves so firmly by the tail to aquatic plants, stones, &c. that they cannot easily be disengaged; they often farther strengthen these attachments by means of one or two of their arms, which serve as a kind of anchors for fixing them to the adjacent substances.

The stomach of the polype is a kind of bag or gut into which the mouth opens, and goes from the head to the tail. This, in a strong light, is visible to the naked eye, especially if the animal be placed between the eye and a candle; for these animals are quite transparent, whatever their colour may be. The stomach, however, appears to more advantage through a powerful magnifier. Mr. Trembley, by cutting one of these animals transversely into three parts, satisfied himself that they were perforated throughout. Each piece immediately contracted itself, and the perforation was very visible through a microscope. The skin which incloses the stomach is that of the polype itself; so that the whole animal, properly speaking, consists only of one skin, in the form of a tube, and open at both ends. No vessels of any kind are to be distinguished.

The mouth is situated at the anterior end in the middle between the shooting forth of the arms, and assumes different appearances according to circumstances; being sometimes lengthened out in the form of a nipple, at others appearing truncated; sometimes the aperture is quite closed, at others there is a hollow; though at all times a small aperture may be discovered by a powerful magnifier.

The skin of a polype, when examined with a microscope, appears like shagreen, or as if covered with little grains, more or less separated from each other, according to the degree of contraction of the body. If the lips of a polype be cut transversely, and placed so that the cut part of the skin may lie directly before the microscope, the skin throughout its whole thickness will be found to consist of an infinite number of grains, and the interior part is found to be more shagreened than the exterior one; but they are not strongly united to each other, and may be separated without much trouble. They even separate of themselves, though in no great numbers, in the most healthy animals of this kind; for, where they are observed to separate in large quantities, it is a symptom of a very dangerous disorder. In the progress of this disorder, the surface of the polype becomes gradually more and more rough and unequal, and no longer well defined or terminated as before. The grains fall off on all sides; the body and arms contract and dilate, and assume a white shining colour; and at last the whole dissolves into an heap of grains, which is more particularly observed in the green polype. By a careful examination we find, that the skin of the polype is entirely composed of grains, cemented by means of a kind of gummy substance; but it is to the grains entirely that the polype owes its colour. The structure of the arms is analogous to that of the body; and they appear shagreened when examined by the microscope, whether they be in a state of contraction or extension; but, if very much contracted, they appear more shagreened than the body, though almost quite

quite smooth when in their utmost state of extension. In the green polype the appearance of the arm is continually varying; and the elevations are more sensible towards the extremity of the arm than at its origin, but more scattered in the parts further on. The extremity is often terminated by a knob, the hairs of which cannot be observed without a very powerful magnifier. They have a remarkable inclination of turning towards the light; so that, if that part of the glass on which they are be turned from the light, they will quickly remove to the other.

That species named the fusca has the longest arms, and makes use of the most curious manœuvres to seize its prey. They are best viewed in a glass seven or eight inches deep, when their arms commonly hang down to the bottom. When this, or any other kind, is hungry, it spreads its arms in a kind of circle to a considerable extent, inclosing in this, as in a net, every insect which has the misfortune to come within the circumference. While the animal is contracted by seizing its prey, the arms are observed to swell like the muscles of the human body when in action. Though no appearance of eyes can be observed in the polype, they certainly have some knowledge of the approach of their prey, and shew the greatest attention to it as soon as it comes near them. It seizes a worm the moment it is touched by one of the arms; and in conveying it to the mouth, it frequently twists the arm into a spiral like a corkscrew; by which means the insect is brought to the mouth in a much shorter time than otherwise it would be; and so soon are the insects on which the polypes feed killed by them, that M. Fontana thinks they must contain the most powerful kind of poison; for the lips scarcely touch the animal when it expires, though there cannot be any wound perceived on it when dead. The worm, when swallowed, appears sometimes single, sometimes double, according to circumstances. When full, the polype contracts itself, hangs down as in a kind of stupor, but extends again in proportion as the food is digested and the excrementitious part is discharged. The bodies of the insects, when swallowed, are first macerated in the stomach, then reduced into fragments, and driven backward and forward from one end of the stomach to the other, and even into the arms, however fine they may be; whence it appears that the arms, as well as the other parts of this remarkable creature, are a kind of hollow guts or stomachs. In order to observe this motion, it is best to feed the polypes with such food as will give a lively colour; such, for instance, as those worms which are furnished with a red juice. Some bits of a small black snail being given to a polype, the substance of the skin was soon dissolved into a pulp consisting of small black fragments; and, on examining the polype with a microscope, it was found that the particles were driven about in the stomach, and that they passed into the arms, from thence back into the stomach, then to the tail; from whence they passed again into the arms, and so on. The grains of which the body of the polype consist take their colour from the food with which it is nourished, and become red or black as the food happens to afford the one colour or the other. They are likewise more or less tinged with these colours in proportion to the strength of the nutritive juices; and it is observable that they lose their colour if fed with aliments of a colour different from themselves. They feed on most insects found in fresh water; and will

will also be supported with worms, the larvæ of gnats, &c. and even with snails, large aquatic insects, and fish or flesh, if cut into small bits. Sometimes two polypes lay hold of the same worm, and each begins to swallow its own end till their mouths meet and the worm breaks. But, should this happen not to be the case, the one polype will sometimes devour the other along with its portion. It appears, however, that the stomach of one polype is not fitted for the dissolving the substance of another; for the one which is swallowed always gets clear again after being imprisoned for an hour or two.

The manner in which the polypes generate is most perceptible in the grisea and fusca, as being considerably larger than the viridis. If we examine one of them in summer, when the animals are most active, and prepared for propagation, some small tubercles will be found proceeding from its sides, which constantly increase in bulk, until at last in two or three days they assume the figure of small polypes. When they first begin to shoot, the excrescence becomes pointed, assuming a conical figure, and deeper colour than the rest of the body. In a short time it becomes truncated, and then cylindrical, after which the arms begin to shoot from the anterior end. The tail adheres to the body of the parent-animal, but gradually grows smaller, until at last it adheres only by a point, and is then ready to be separated. When this is the case, both the mother and young ones fix themselves to the sides of the glass, and are separated from each other by a sudden jerk. The time requisite for the formation of the young ones is very different, according to the warmth of the weather and the nature of the food eaten by the mother. Sometimes they are fully formed, and ready to drop off, in twenty-four hours; in other cases, when the weather is cold, fifteen days have been requisite for bringing them to perfection.

It is remarkable, that there is a reciprocal communication of food betwixt the young and the old before they be separated. The young ones, as soon as they are furnished with arms, catch prey for themselves, and communicate the digested food to the old ones, who on the other hand do the same to the young ones. This was fully verified by the following experiment: one of the large polypes of the fusca kind being placed on a slip of paper in a little water, the middle of the body of a young one growing out from it was cut open; when the superior part of that end which remained fixed to the parent was found to be open also. By cutting over the parent polype on each side of the shoot, a short cylinder was obtained, open at both ends; which being viewed through a microscope, the light was observed to come through the young one into the stomach of the old one. On cutting open the cylindrical portion lengthwise, not only the hole of communication was observed, but one might see through the end of the young one also. On changing the situation of the two pieces, the light was seen through the hole of communication. This may be seen between the parent polype and its young ones after feeding them; for, after the parents have eaten, the bodies of the young ones swell as if they themselves had been eating.

The polypes produce young ones indiscriminately from all parts of their bodies, and five or six young ones have been produced at once; nay, Mr. Trembley has observed nine or ten produced at the same time.

Nothing

Nothing like copulation among these creatures was ever observed by Mr. Trembley, though for two years he had thousands of them under his inspection. To be more certain on this subject, he took two young ones the moment they came from their parent, and placed them in separate glasses. Both of them multiplied, not only themselves, but also their offspring, which were separated and watched in the same manner to the seventh generation; they have even the same power of generation while adhering to their parent. In this state the parent with its children and grandchildren, exhibit a singular appearance, looking like a shrub thick set with branches. Thus several generations sometimes are attached to one another, and all of them to one parent. Mr. Adams gives a figure of one polype with nineteen young ones hanging at it; the whole group being about an inch broad, and an inch and an half in length: the old polype ate about twelve monoculi per day, and the young ones about twenty among them.

When a polype is cut transversely or longitudinally into two or three parts, each part in a short time becomes a perfect animal; and so great is this prolific power, that a new animal will be produced even from a small portion of the skin of the old one. If the young ones be mutilated while they grow upon the parent, the parts so cut off will be reproduced, and the same property belongs to the parent. A truncated portion will send forth young ones before it has acquired a new head and tail of its own, and sometimes the head of the young one supplies the place of that which should have grown out of the old one. If we slit a polype longitudinally through the head to the middle of the body, we shall have one formed with two heads; and by slitting these again in the same manner we may form one with as many heads as we please.

A still more surprising property of these animals is, that they may be grafted together. If the truncated portions of a polype be placed end to end, and gently pushed together, they will unite into a single one. The two portions are first joined together by a slender neck, which gradually fills up and disappears, the food passing from the one part into the other; and thus we may form polypes not only from portions of the same but of different animals; we may fix the head of one to the body of another, and the compound animal will grow, eat, and multiply, as if it had never been divided. By pushing the body of one into the mouth of another, so far that their heads may be brought into contact, and kept there for some time, they will at last unite into one animal, only having double the number of arms which it would otherwise have had. The *hydra fusca* may be turned inside out like a glove, at the same time that it continues to live and act as before. The lining of the stomach now forms the outer skin, and the former epidermis constitutes the lining of the stomach. If previous to this operation the polype have young ones attached to it, such as are but newly beginning to vegetate turn themselves inside out, while the larger ones continue to increase in size till they reach beyond the mouth of the parent, and are then separated in the usual manner from the body. When thus turned, the polype combines itself in many different ways. The fore part frequently closes and becomes a supernumerary tail. The animal, which was at first straight, now bends itself, so that the two tails resemble the legs of a pair of compasses, which it can open and shut. The old mouth is placed

placed as it were at the joint of the compasses, but loses its power of action; to supply which, a new one is formed in the neighbourhood; and in a little time there is a new species of hydra formed with several mouths.

The sides of the polype, which has been cut through in a longitudinal direction, begin to roll themselves up, commonly from one of the extremities, with the outside of the skin inwards; but in a little time they unroll themselves, and the two cut edges join together, sometimes beginning at one extremity, and sometimes approaching throughout their whole length. As soon as the edges join, they unite so closely that no scar can be perceived. If a polype be partly turned back, the open part closes, and new mouths are formed in different places. Every portion of a polype is capable of devouring insects almost as soon as it is cut off: and the voracity of the whole genus is astonishing; for Mr. Adams observes, that most of the insects on which they feed bear the same proportion to the mouth of a polype that an apple of the size of a man's head bears to his mouth.

The *hydra pallens* is very rarely met with, and is described only by M. Roefel. It is of a pale-yellow colour, growing gradually smaller from the bottom; the tail is round or knobbed; the arms are about the length of the body, of a white colour, generally seven in number, and are apparently composed of a chain of globules. The young are brought forth from all parts of its body.

The *hydratula* is mentioned by many medical writers. Dr. Tyson, in dissecting an antelope, found several hydatides or films, about the size of a pigeon's egg, filled with water, and of an oval form, fastened to the omentum; and some in the pelvis between the bladder of urine and rectum. He suspected them to be animals for the following reasons: 1. Because they were included in a membrane like a matrix, so loosely, that, by opening it with the finger or a knife, the internal bladder, containing the serum or lymph, seemed no where to have any connection with it, but would very readily drop out, still retaining its liquor without spilling any. 2. This internal bladder had a neck or white body, more opaque than the rest, and protuberant from it, with an orifice at its extremity; by which, as with a mouth, it exhausted the serum from the external membrane, and so supplied its bladder or stomach. 3. On bringing this neck near the candle, it moved and shortened itself. It is found in the abdomen of sheep, swine, mice, &c. lying between the peritoneum and the intestines.

The *stentorea*, or funnel-like polype, is of three colours, green, blue, and white; but the last is the most common. They do not form clusters, but adhere singly by the tail to whatever comes in their way: the anterior end is wider than the posterior; and, being round, gives the animal somewhat of a funnel form, though the circle is interrupted by a kind of slit or gap. The edge of this gap is surrounded with a great number of little fimbriæ, which by their motions excite a current of water, that forces into the mouth of the animal the small bodies that come within its reach. Mr. Trembley says, that he has often seen a great number of animalcules fall into the mouths of these creatures; some of which were let out again at an opening which he could not describe. They can fashion their mouths into several different forms; and they multiply by dividing neither transversely nor longitudinally, but diagonally.

The

The socialis is described by Muller under the title of vorticella. They are found in clusters; and, when viewed by a microscope, appear like a circle surrounded with crowns or ciliated heads, tied by small thin tails to a common centre, from whence they advance towards the circumference, and then turn like a wheel, occasioning a vortex which brings along with it the food proper for them.

The anastatica, or clustering polypes, form a group resembling a cluster, or rather an open flower, supported by a stem, which is fixed by its lower extremity to some of the aquatic plants or extraneous bodies that are found in the water; the upper extremity is formed into eight or nine lateral branches, perfectly similar to each other, which have also subordinate branches, whose collective form much resembles that of a leaf. Every one of these assemblages is composed of one principal branch or nerve, which makes the main stem of the cluster an angle somewhat larger than a right one: the smaller lateral branches proceed from both sides of this nerve, and these are shorter the nearer their origin is to the principal branch. There is a polype at the extremity, and others on both sides of the lateral twigs, but at different distances from their extremities. They are all exceedingly small, and bell-shaped, with a quick motion about the mouth, though it is impossible to discern the cause of it.

The several strange properties recorded of this animal, though very surprising, are, however, none of them peculiar to it alone. The Surinam toad is well known to produce its young, not in the ordinary way, but in cells upon its back. Mr. Sherwood has very lately discovered the small eels in four paste to be without exception full of living young ones. And as to the most amazing of all its properties, the reproduction of its parts, we know the crab and lobster, if a leg be broken off, always produce a new one: and Monf. Bonet, Monf. Lyonet, Monf. de Reaumur, and Mr. Folkes, have all found, by experiment, that several earth and water worms have the same property, some of them even when cut into thirty pieces. The *urtica marina*, or sea-nettle, has been also found to have the same; and the sea star-fish, of which the polype is truly a species, though it had long escaped the searches of the naturalist, was always well known by the fishermen to have it also.

The marine polypus is different in form from the fresh-water polype already described; but is nourished, increases, and may be propagated, after the same manner; Mr. Ellis having often found, in his inquiries, that small pieces cut off from the living parent, in order to view the several parts more accurately, soon gave indications that they contained not only the principles of life, but likewise the faculty of increasing and multiplying into a numerous issue. It has been lately discovered and sufficiently proved by Peyssonel, Ellis, Jussieu, Reaumur, Donati, &c. that many of those substances which had formerly been considered by naturalists as marine vegetables or sea-plants, are in reality animal productions; and that they are formed by polypes of different shapes and sizes, for their habitation, defence, and propagation. To this class may be referred the corals, corallines, keratophyta, eschara, sponges, and alcyonium: nor is it improbable, that the more compact bodies, known by the common appellations of star-stones, brain-stones, petrified fungi, and the like, brought from various parts of the East and West Indies, are of the same origin. To this purpose Mr. Ellis observes, that the

ocean, in all the warmer latitudes near the shore, and wherever it is possible to observe, abounds so much with animal life, that no inanimate body can long remain unoccupied by some species. In those regions, ships bottoms are soon covered with the habitations of thousands of animals : rocks, stones, and every thing lifeless, are covered with them instantly ; and even the branches of living vegetables that hang into the water are immediately loaded with the spawn of different animals, shell-fish of various kinds : and shell-fish themselves, when they become impotent and old, are the basis of new colonies of animals, from whose attacks they can no longer defend themselves.

METHOD OF RAISING EARLY POTATOES.

HITHERTO KEPT SECRET AMONGST A FEW PLANTERS.

LANCASHIRE was the first county in this kingdom in which the potatoe was grown ; and as it is able at this day to boast a superior cultivation in that important article, in which it still stands unrivalled, it may be requisite to descend to particulars in regard to the management of that crop.

A sward, or fresh lay, is desirable, but not always requisite.— Good crops have been frequently raised from lands exhausted. The ground being previously cleaned by ploughings, and planted (if the ground can be got into condition in April) in drills about three feet distance, and from twelve to nine inches asunder, in each drill, the sets placed immediately upon long dung from the yard, &c. but dung from the great towns produces a wonderful effect upon lands not formerly accustomed to that article, and it is supposed will generally enrich twice as far, with equal effect, as the manure formerly used from the farm-yard, &c. This is experienced in the lands bordering upon the canals.

Although April be the prime season for producing a crop of good potatoes for the table, because this vegetable requires a certain portion of time to acquire that degree of maturity which renders it peculiarly mellow and farinaceous, yet it is frequently planted as late as May, or even June, and yet produces abundant crops, but not of the same matured quality as those planted at a more early season.

The apprehension of frosts (by which, if the tops are caught, after breaking the surface, they pine and sicken, and the hopes of the husbandman are blasted) sometimes operates against this early season ; yet good planters risque the chance of frosts, in order that they may obtain superior quality.

The crops are kept clean from weeds by the plough, first by turning a furrow, left for that purpose, towards the young plants, as soon as they appear ; and then by turning a furrow from each side of the drill, and which is sometimes, if very foul, harrowed by a small triangular harrow, running through each drill.—After the weeds have been so exposed, the furrow is turned back again, and sometimes the same plough, or a double-wrested one, run up each drill once more ; besides the destruction of weeds, the land, by these operations, is loosened, and exposed to the sun and air, which contributes greatly to improve the crop.

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The variety of seeds in use are numerous—Ox-noble, and the cluster potatoe, are planted for the cattle; the pink-eye, and a variety of others, with different kinds of kidney-potatoes, for the table. The old winter-red, as it is sometimes called, ought to be mentioned for its peculiar goodness in the spring, when other kinds have lost their flavour; this potatoe is then in its best perfection; it has another quality, that of never having been known to curl.—There are also great varieties of early potatoes, and great attention is paid to raising new sorts of the best qualities from seeds, of what is called the crabs, or suckles, which grow upon the stems.

Great attention is paid to changing the seed occasionally, to prevent the curl, the practice of obtaining fresh seed from Scotland (as was the custom a few years ago) is not now so frequent; a change from the moss lands, and *vice versa*, being generally sufficient. A change of land is also desirable, but not always practicable; crops have been successfully taken, for a succession of years, from the same lands.

The produce of a crop is, on a medium, from two to three hundred measures, or bushels, the statute acre. The early potatoes are generally planted in beds, in rows about eight inches distant, and the sets about four or five inches separate, because those early potatoes, being of a less size, require a smaller space; but the advanced price these early crops fetch at market render them a profitable article to the cultivator, who, besides reaping a profit from this early produce, has his grounds prepared for another crop the same season. Mr. Eccleston describes a piece of ground of thirty perches, (eight yards to the perch,) the early potatoes raised upon which had been sold for thirty pounds, in the year 1793, after which a crop of turnips had been grown, which, at sixpence per bushel, were worth fifty pounds per acre; after which the same land was to be cropped with wheat.—The markets of Manchester, Oldham, Rochdale, and the neighbourhood, are supplied with great quantities, not only from Warrington, but as far as Rufford, Scarisbrick, &c.

Upon the same ground from which a crop has already been taken, the early seed potatoes are in some places afterwards planted, and which, after being got up about November, and immediately cut up into sets, and preserved in oat-shells, or saw-dust, where they remain till March, when they are planted, after having taken off one sprit, and planted with another of a length sufficient to appear above ground in the space of a week. But the most approved method is, that they cut the sets, and put them on a room floor, where a strong current of air can be introduced at pleasure, the sets laid thinner, viz. about two lays in depth, and covered with the like materials (shells or saw-dust) about two inches thick:—This screens them from the winter frosts, and keeps them moderately warm, but at the same time admits air to strengthen them, and harden their shoots, which they improve by opening the doors and windows on every opportunity of mild soft weather: they frequently examine them, and when the shoots are sprung an inch and a half, or two inches, they carefully remove one half of their covering, with a wooden rake, or with the hands, taking care not to disturb or break the shoots; in this manner they remain till the planting season, giving them all the air possible by the doors and windows, when it can be done safely from frost: by this method, the shoots at top become green, leaves are

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sprung,

sprung, and moderately hardy. They plant them in rows, in the usual method, by a setting-stick, and carefully rake up the cavities made by the setting-stick; by this method they are enabled to bear a little frost without injury. The earliest potatoe is the superfine white kidney; from this sort, upon the same ground, have been raised four crops, having sets from the repository ready to put in as soon as the others were taken up; and a fifth crop is sometimes raised from the same lands of winter lettuce. This excellent information was communicated by Mr. J. Blundell, of Ormskirk, and has hitherto been kept a secret amongst a very few gardeners.

The manner of taking them up varies. The three-pronged fork is in general use—the soil turned over, the weeds picked out, the potatoes gathered and separated according to their size, by the same person. Another practice is for a strong man to take a three-pronged fork, but crooked (the same which is generally used to pull dung out of the cart) which he strikes down between every root, and pulls over, laying the roots bare, which are taken up by two children that follow. Another practice is, to turn a furrow from the potatoes with a Rotherham plough, and then with another plough, furnished only with a share, to turn up the potatoes, which are afterwards gathered.

After the potatoes are gathered up, and when sufficiently dried, they are put together in heaps, in the shape of the roof of a building, covered closely with straw, which should be drawn straight, and to meet from each side in a point at the top, about six inches in thickness, and then covered with mould, closely compacted together, by frequent applications of the spade; after which, Mr. Eccleston makes holes in the mould, at the sides and tops of these repositories, as deep as the straw, and about three yards distant, to permit the air, which, he says, visibly arises from the fermentation, to escape; after the fermentation has ceased, the holes are closed, to prevent the effects of frosts or rain.

The utility of the application of potatoes to feeding stock is sufficiently known, but not sufficiently practised.—Converting the produce into immediate cash, by taking it to market, is a stronger temptation than waiting the more tedious process of purchasing stock, and fattening the cattle; but a source of improvement to the land, and consequently superior in the issue, is by this means done away.

From the great quantities consumed by stock, it may not be amiss to mention the manner of boiling, &c. which is almost universally by steam, in a large hamper or tub, perforated, and placed over the water; in this way they are readier for use than by being immersed in water; after which they are given either warm or cold, mixed with chaff, bran, hay-seeds, barley, or oat-meal.

To conclude, if America, whence this choice vegetable was first imported, had yielded nothing else to the researches of the European than the potatoe, the present generation would have reason to be thankful for the acquisition, and to the planters in Lancashire, for their spirited attention to its cultivation.

The bushel mentioned in Mr. Young's Farmer's Tour is only 48lb. which accounts for the large number of bushels, four hundred and twenty-seven, at which he averages the product of an acre.

A statute acre in Walton, last year, produced two hundred and twenty-eight bushels of 90lb. which is exactly Mr. Young's average, or four hundred and twenty-seven bushels of 48lb.

ON PREDICTION AND FOREKNOWLEDGE.

THE most important actions of our life are marked in Heaven before the thoughts come into our mind of producing them; as those of our birth and death, the two extremities of our career; and also many others which mark the summit of our greatest happiness or our misery. All the misfortunes which come into the world, or shall appear hereafter, arise from the same principle of foreknowledge from the first moment of time; some happen sooner, others later, according to the order prescribed them by the Almighty Power. I would not with any man to fasten an absolute necessity to the event of their effects, because a clear foresight may, in some measure, avoid the danger of the wound, though not the stroke. Many, to prove the necessity of all things, say, that what has happened was unavoidably to happen; but this necessity ought only to refer to the consequence, and not to a following conclusion; that is to say, supposing the thing has happened, it necessarily follows it must happen. This necessity is then no other than the infallibility of an event in its nature free and indifferent, whether for the past or the future. For as it is a common saying, that it was necessary what has happened should happen; so, by the same rule, one may say, that what is decreed to happen will happen.

As to predictions, sometimes from the most ignorant among men, it is an error to add an implicit belief to them on all occasions; but it is certainly no fault to screen ourselves when we are threatened with an approaching rain.—Had Percillas hearkened to the advice of his friend, he would have escaped shipwreck.—Torcleya despised the accounts given him of his death three days before he died; and the little care he took of his life in an imminent danger rendered him too secure in the moment of his misfortune.

Tarcinus said to Locrias, in the midst of a feast, that he would die in the desert if he did not drink to the gods; that is to say, if he did not implore their protection in the misfortune he had engaged himself in. This advice he neglected, and he did not fail of meeting his death in the poisoned cup that was presented to him.—Lelianus king of the Lacques caused Servianus to be punished for having predicted to him that he would die in an hour if he quitted his apartment, and the prediction was so true, that, before the unfortunate Servianus had received the full number of stripes to which he had been so unjustly condemned, the king touched the last moment of his life.—Philip, king of the Macedonians, was warned by the oracle of Apollo, to beware of receiving his death by a chariot. To avoid the misfortune, the king ordered out of his dominions all the wheeled vehicles that could be found: yet, for all his precaution, he could not shun the fate ordained for him.—Pausanias, who gave this monarch the stroke of death, had a chariot engraven on the hilt of his sword.

HISTORY OF THE POLYGARS.

THE Polygars are natives of Hindostan. They inhabit almost impenetrable woods, and are under the absolute direction of their own chieftains. In time of peace they are professionally robbers, but in times of war are the guardians of the country. The
general

general name of these people is Polygar. Their original institution, for they live in distinct clans, is not very well understood. It probably took its rise from the municipal regulations relative to the destruction of tigers and other ferocious beasts. Certain tracts of woodland were indisputably allotted as rewards to those who should slay a certain number of those animals; and those lands approximating, probably laid the foundation of the several confederacies of Polygars.

The Pollams, or woods, from which is derived the word Polygar, lying in profusion through all the southern parts of Hindostan, the ravages committed in the open countries by these adventurous clans are both frequent and destructive. Cattle and grain are the constant booty of the Polygars. They not unfrequently even despoil travellers of their property, and sometimes murder, if they meet with opposition: yet these very Polygars are the hands into which the aged and infirm, the wives, children, and treasure, of both Hindoos and others are entrusted, when the circumjacent country unfortunately happens to be the seat of war. The protection they afford is paid for; but the price is inconsiderable, when the helpless situation of those who fly to them for shelter is considered, and especially when their own very peculiar character is properly attended to. The native governments of Hindostan are under the necessity of tolerating this honourable banditti. Many of them are so formidable as to be able to bring from fifteen thousand to twenty thousand men into the field.

The Hindoo code of laws, in speaking of robberies, hath this remarkable clause, 'The mode of shares amongst robbers shall be this:—If any thief or thieves, by the command of the magistrate, and with his assistance, have committed depredations upon, and brought away any booty from, another province, the magistrate shall receive a share of one sixth part of the whole. If they received no command or assistance from the magistrate, they shall give the magistrate in that case one tenth part for his share, and of the remainder their chief shall receive four shares; and whosoever among them is perfect master of his occupation shall receive three shares: also, whichever of them is remarkably strong and stout shall receive two shares, and the rest shall receive one share.' Here, then, we see not only a sanction, but even an inducement, to fraudulent practices.—Another singular inconsistency among a people who, in many periods of their history, have been proverbial for innocency of manners, and for uncommon honesty in their conduct towards travellers and strangers.

At the first sight, it would appear that the toleration of the Polygars, owing to their great numbers, and to the security of their fortresses, which are in general impenetrable but to Polygars; that the government licence, in this manner given to them, to live on the spoils of the industrious—might have originally occasioned the formal division, and encouragement to perseverance, which we have just quoted: but the cause I should rather suppose to lie in the nature of certain governments, than to have arisen from any accidental circumstance afterwards; and I am the more inclined to this opinion, from the situation of the northern parts of Hindostan, which are, and always have been, uninfested by these freebooters.

The dominion of the East was, in former days, most probably divided and subdivided into all the various branches of the feudal system.

system. The vestiges of it remain to this hour: rajahs and zemindars are nothing more than chieftains of a certain degree of consequence in the empire. If, then, experience has shewn, in other parts of the world, that clans have always been observed to commit the most pernicious acts of depredation and hostility on each other, and that the paramount lord has seldom been able effectually to crush so general and so complicated a scene of mischief—may we not reasonably venture to suppose, that the Hindoo legislature passed this ordinance for the suppression of such provincial warfare, and for the wholesome purpose of drawing the people, by unalarming degrees, more immediately under the controul of the one sovereign authority? The conclusion, I own, appears to me satisfactory. Moreover, Polygars cannot but be of modern growth; for the law relative to thefts is antecedent to the mention of Polygars in history.

LIFE OF LINNÆUS, THE CELEBRATED NATURALIST.

A FEW men exist in every age who make so conspicuous a figure in the temple of fame, as to render the minutest circumstances respecting them peculiarly interesting. It cannot, indeed, be said that the collection of such circumstances is an object of capital importance to literature or the study of mankind: but, as they are found to afford very general amusement, the public are under obligations to those who bestow much time and labour in order to entertain them in this manner. The celebrated Linnæus will scarcely be refused a place among those who stand forward on the list of eminent men in the period in which they have respectively lived. He formed an *era* in a very extensive, pleasing, and interesting, science, and threw a lustre not only on his own name and profession, but on his country. A biographical account of so extraordinary a genius cannot, therefore, fail of engaging the curiosity of a great number of readers; and particularly those who are fond of Natural History.

Linnæus was the son of a peasant-born village pastor, who brought up a family in the narrow condition attending that station in the north of Europe. The fondness of young Linnæus for plants, which shewed itself at so early an age as to appear almost instinctive, may readily be derived from the father's taste for horticulture, and for the collection of wild flowers from the woods and fields around his little mansion. The youth was destined for the church: but an impatience of confinement to studies which he did not relish, and the insuperable attachment to Flora which possessed his mind, frustrated the intentions of his parents. When, in displeasure and despair, they were about to bind him apprentice to a shoemaker, he was rescued by a physician of the neighbouring town, named Rothmann: who, discovering in him the latent fire of genius, took him into his house as a pupil, and probably as an useful domestic, initiated him in medicine, and decided his fate by putting into his hand Tournefort's Elements of Botany.

In the 21st year of Linnæus's age, he went to the university of Lund. In this place he had the good fortune to ingratiate himself with Stobæus, professor of physic and botany, who took him gratuitously into his family, and gave him access to his museum and library. A pleasing anecdote is related of him during his residence in

in this house :—As he was of a social convivial turn, and was known to sit up late at night, the professor suspected that his vigils passed in cards or romps with the servants. He therefore came suddenly into the young man's apartment at a late hour; when, instead of amusements of that kind, he found him entrenched amidst the works of Tournefort, Bauhin, Cæsalpinus, and other great botanists. This discovery, as might be supposed, rendered him a greater favourite with the professor than before.

The university of Upsal, however, the chief seat of the Swedish Muses, was the great object of his longing; and, notwithstanding the pecuniary difficulties which stood in his way, he accomplished his journey thither in the next year. The medical professors there at that period, namely, in 1728, were Olaus Rudbeck, jun. and Roberg, both old men, and little inclined to improvement :—but Olaus Celsius, the professor of divinity, was the best botanist in Sweden, and zealous for the science. He was absent for some time after the arrival of Linnæus; and the poor youth, unknown and unpatronized, fell into a lamentable state of indigence. He was glad to accept of a meal, and to wear the cast clothes of his fellow students; nay he even was forced to patch their old shoes with cards and the bark of trees, in order to be able to make his botanical excursions. The mind, which possesses energy and resolution enough to rise above such difficulties as these, is of the very first class, and may claim praise to which those who are nursed in the lap of ease and prosperity can never establish an equal right. On the return of Celsius, fortune proved more favourable: Linnæus made himself known to him, engaged his esteem, and obtained free board and lodging in his house; which he in some measure repaid, by his services in assisting the professor in composing his *Hierobotanicon*.

About this time, a small work of Vaillant, a very ingenious French botanist, (his *Sermo de Structura Florum*,) falling into the hands of Linnæus, afforded him the first notions of those sexual distinctions of flowers which afterwards became the ground-work of his celebrated system. Attracted by these new views of the vegetable creation, he pursued the subject with many additional observations, and drew up a manuscript treatise on the sexes of plants. This attempt came to the knowledge of Professor Rudbeck, and gave him such an opinion of the writer, that he took Linnæus into his house, and appointed him his assistant lecturer. This was in 1730, when Linnæus had completed his 23d year. Thus the path to fame and advancement was laid open to him, and the whole remainder of his life consisted in a continual and rapid progress through it.

The next advancement of Linnæus, was his appointment, by the Swedish Academy of Sciences, to make a journey of discovery in Lapland. Such was the poverty of Sweden, that the sum devoted to this purpose amounted only to 7l. 10s. sterling! He undertook this long and most uncomfortable expedition with all the ardour of an enthusiast; and, during the course of it, (from May to the end of October,) he underwent dangers and difficulties which, accustomed as he was to hardships, exercised all his patience and resolution:—but he returned rich in many undescribed objects of nature, and in observations on the country and its inhabitants. His diary kept on this tour remains in MS. but the botanical matter was published in two parts of a *Florula Lapponica*, inserted in the Swedish Transactions.

actions. The plants in this catalogue were arranged according to his newly-projected sexual system.

Having now acquired some celebrity, he began, in the year 1733, to give lectures on botany, chemistry, and mineralogy, at Upsal; which were well received. The spirit of envy and rivalry, however, instigated Professor Rosen to enforce a statute of the university, which excluded every one, who had not taken his degrees; from the office of a public lecturer. Stung to the quick with this ungenerous treatment, which blasted all his prospects, Linnæus was provoked to shew his resentment in a very unwarrantable manner. He drew his sword on Rosen as he came out of the senate-house, and was with difficulty prevented from running him through the body: nay, he for some time continued to meditate a bloody revenge, and would probably have executed it, had he not, as he himself related, been diverted from the design by the impression which his mind received one night on waking from a horrid dream. From this anecdote, an idea may be formed of the fiery and resentful temper which, through life, too much characterized the hero of this narrative.

A journey to Dalecarlia, with some young nobles, his pupils, was the occasion of his tarrying at the mining town of Fahlun, where he established a kind of college of mineralogy under the auspices of the governor of the province. Here he became acquainted with the daughter of Moræus, a man of eminence, and physician to the province, and with difficulty obtained the father's consent to marry her in three years, if she should remain single till that period. His great object now was to gain a doctor's degree, and to settle in the practice of physic. By the help of his intended bride, he was equipped for a journey to Hardenwyk in Holland. He took his course by Hamburgh to Hardenwyk: at which university he obtained the degree of doctor of physic. For his academical exercise, he defended a new hypothesis concerning the causes of intermitting fevers; one of the principal of which he asserted to be, the use of water impregnated with argillaceous particles. His thesis bears the date of June 24, 1735, when he was in his 28th year. Leyden was the next place which he visited; where his great object was to obtain an introduction to Boerhaave. This was no easy matter, as that celebrated man set too high a value on his time to be liberal of it in conferences with strangers:—but the prospectus of his *Systema Naturæ*, which Linnæus printed for the first time at Leyden, and presented to Boerhaave, obtained for him the honour which he solicited. The great man appointed an interview at his villa; which succeeded so well for Linnæus, that the old professor advised him to give up all thoughts of returning home, and to seek his fortune in Holland. Linnæus pleaded his disability, on account of indigence, and mentioned his design of leaving Leyden the very next day. We are not told that Boerhaave (one of the richest men in his country) made any effort to detain him. He gave him, however, a letter to Burmann, botanical professor at Amsterdam, which secured him a good reception there; and Burmann conceived so high an opinion of the Swede, that he took him into his house for the purpose of obtaining his help in his *Description of the Plants of Ceylon*. Boerhaave farther served Linnæus very essentially by recommending him to George Clifford, the rich burgomaster and great collector of Amsterdam, as his house physician and botanist. Clifford, accordingly, made an exchange with

with Burmann of a copy of Sloane's History of Jamaica against the naturalist; and he took Linnæus home with him to Hartecamp, his villa, and at once raised him to a state of affluence scarcely conceivable by a poor Swede, for he had an appointment of a ducat a day, exclusively of board.

The residence in a paradise fraught with treasures from all parts of the globe, together with books, learned company, and good living, must have made Linnæus the happiest of mortals. He studied, wrote, and extended his fame and principles. An agreeable variation of his employments was a journey to England in 1736, at Clifford's expense, for the purpose of enriching his garden. Sir Hans Sloane was at that time at the head of natural history in this country: but a warm recommendation of Linnæus to him, from Boerhaave, procured only a cold and common reception. Linnæus visited Miller at the Chelsea-garden, and, after some unpromising attempts, succeeded in inspiring that botanist with a favourable opinion of him. A man of superior knowledge, Dillenius, at Oxford, received him at first with jealousy and dislike, but at last treated him with civility. The botanical garden at Oxford seems to have been what best answered the expectations of the great Swedish botanist in England; and he returned to Hartecamp enriched with many natural treasures, and furnished with new connexions, which proved of subsequent utility to him.

Linnæus now proceeded with renewed spirit and confidence in his great plan of botanical reform, and he gave to the world his first edition of the *Genera Plantarum* in the beginning of 1737. In this, the sexual system was displayed in its complete state; and he arranged, according to the same method, the *Hortus Cliffortianus* and the *Flora Lapponica*, which both appeared in that year. The reputation which he gained by these works did not prevent his becoming a prey to melancholy; the true cause of which was a longing after his own country, and for the sight of his intended bride. Having resided a while with Van Royen in Leyden, whom he aided in forming a new system of botany, he visited Paris, where he met with a polite reception, and was admitted a corresponding member of the Academy of Sciences. France, however, was not yet prepared for exchanging the system of her own Tournefort and Vaillant for that of the Swede. From this country he took his departure by sea for Sweden, where he arrived in September 1738.

It may not be amiss to notice a summary of Linnæus's literary contests and opponents. The great Haller, his superior in general knowledge, but his inferior in originality and the spirit of system, is placed first on the list; yet it was only in occasional criticisms and reviews of the works of Linnæus that Haller publicly appeared as his opponent; and he was more habitually his friend, correspondent, and admirer. Their friendship, however, was interrupted, and at length terminated, by jealousies and bickerings; in which the pride and petulance of Linnæus seem fully as much to blame as the more stately self-consequence of Haller. Professor Heister was a more bitter and much less respectable antagonist; and he spirited up one of his pupils, Siegesbeck, to fall on Linnæus in a manner that only exposed his own ignorance and presumption. It was a temporary triumph for Heister, that, after unsuccessfully attacking the sexual system, he could adduce a small publication of John Henry Burk-

hard,

hard, a German physician, dated 1702, in which a hint is given of the possibility of forming an arrangement of plants according to the differences of their parts of generation:—but Linnæus could prove that he never saw this obscure performance; and if he had, it could have detracted little from his merit, that another had slightly suggested a plan which he had brought to execution. Many respectable names, however, appear as opponents of the new system; among whom may be mentioned Klein, Crantz, Alston, Camper, Pontedera, Spalanzani, Adanson, and the illustrious de Buffon. In his own country, Linnæus had a declared and acrimonious adversary in the great mineralogist Wallerius. In order to refute the aspersions of this philosopher, Linnæus printed a small anonymous work entitled *Orbis eruditi judicium de Car. Linnæi M. D. scriptis*, in which he drew a sketch of his life and writings, and published all the testimonies in his favour given by men of eminence, in various parts of Europe. This was a dignified, though perhaps an ostentatious, mode of silencing attacks; more to his honour, however, than the method which he is here said to have taken in order to mark his sense of gratitude and of resentment toward foreign botanists—which was, by affixing the names of his friends on beautiful and valuable plants, and those of his enemies on the ugly and noxious. Here was a display of that littleness of mind which mixed itself with his great qualities; and the temptation, thus to abuse the assumed botanical privilege of naming new plants after persons, justifies Haller's objections against that common practice.

Our hero now returned to Stockholm. His botanical honours had not done much in preparing the way to medical practice; and his prospects were at first so little encouraging, that, had a letter from Haller come to hand in reasonable time, in which that eminent person proposed in the most friendly manner to resign to him his own professorship of botany at Gottingen, Sweden would probably have lost the honour and advantage of Linnæus's future residence. Some fortunate cases, however, brought him into notice; and a lucky prescription for a cough became so fashionable, as to give him an introduction at court. Count Tessin declared himself the patron of Linnæus, and obtained for him the post of physician to the admiralty; this success also gained him the hand of his bride, after a probation of five years.

The death of Olaus Rudbeck, at Upsal, made a vacancy in the botanical chair at that university, and Linnæus's great wish was to succeed to this post. His first application was unsuccessful, and Rosen his old antagonist was the person elected. This disappointment was softened by the choice which the Swedish diet made of Linnæus to take a tour, accompanied by subordinate naturalists, through some of the least-known provinces of the kingdom, in order to promote useful knowledge and improvement. On his return from this agreeable and reputable mission, another professorship at Upsal, that of physic and anatomy, became vacant; and, it being conferred on him, he removed thither, with his family, in September 1741, and assumed his public functions. Soon afterwards, Rosen and he, reflecting that they were each in the wrong place, made an amicable exchange of professorships, with universal consent: and, from the beginning of 1742, Linnæus occupied that station, which he rendered so honourable to himself, and so useful to the university.

His first care was to re-establish and improve the botanical garden, which had fallen into lamentable decay. He was in fact the new creator of it, and by his interest and assiduity it became one of the most celebrated of the public repositories of plants. A cabinet of natural curiosities was likewise formed at Upsal by the influence of Linnæus, aided by the patriotic munificence of Count Gyllemborg, chancellor of the university.

Linnæus was now thoroughly engaged in his academical functions. Besides botany, he lectured on natural history in general, the materia medica, dietetics, and the distinction of diseases; and students flocked to hear him. He was employed in two more exploratory tours in his own country; to West Gothland in 1746, and to Schonen in 1749; and he published a complete Flora and Fauna of Sweden. Honours, both foreign and domestic, accumulated on him; of which one of the most singular and flattering was that of having a medal struck with his effigy, at the expence of four Swedish nobles. He obtained the title of Archiater (Dean of the College of Physicians); and thus his father, who had destined him for a shoemaker, saw his son raised to honours and dignities, famous throughout Europe, and in possession of an immortal name!

Many of the pupils of Linnæus travelled into foreign climates in order to extend the sphere of natural knowledge. No circumstance, perhaps, in the life of this eminent person is so truly honourable to him as his having been the founder of such a school of able and enterprising men; whose zeal for their favourite pursuits carried them through dangers and difficulties into the most remote parts of the globe, to the infinite emolument of science. To several of them this zeal proved fatal.

The events of Linnæus's life, from 1750 to 1760, are interesting. He arranged and described the cabinet of Count Tessin, and various royal museums. He made an important discovery respecting the tænia, proving that it partakes of the nature of the polype, and that each joint is a separate animal. He found out, as his biographer roundly asserts, the art of making pearls: but, though it is certain that he imagined he had made this discovery, and that great public expectations were raised from it, yet it does not appear that his project ever was brought to practice. Various new observations respecting the physiology of plants resulted from his farther inquiries; particularly that plants undergo a nocturnal change analogous to sleep in animals.

In 1751, he published a view of his whole system, together with those of the principal botanists who preceded him, in a work entitled *Philosophia Botanica*, which displayed his ingenuity and talent for method and arrangement in the most striking manner.

His capital work, the *Species Plantarum*, first appeared in 1753, and exhibited such a catalogue of vegetables as the world had not before seen. Besides the vast number of new species from all quarters of the globe which it contained, it presented his most useful invention of trivial names, by which the language of botany obtained an unspeakable advantage in point of facility and distinctness. His reputation was daily more and more extended through foreign countries, bringing him continual accessions of curiosities for the botanical garden and museum, and procuring to him the most honourable invitations from the distant capitals of Madrid and Petersburg; both

which

which he declined in favour of his native land. Indeed he had reason to be satisfied with the respect paid to him at home; for the new order of the Polar Star was conferred on him in 1753; and in 1757 he received a patent by which he was raised to the rank of the hereditary nobility of the kingdom.

The last labours of Linnæus in botany were the supplements published in 1767 and 1771, and the accounts of single plants transmitted to him after 1774. During the whole course of this latter period of his life, he was receiving numerous testimonies of respect from learned and academical bodies, which now acquired more honour than they could confer, by the association of such a name to their lists of members. In 1763 he had the satisfaction of obtaining the appointment of his son as assistant to him in the botanical chair, with the promise of his succeeding to it when it should become vacant. His wife's fortune, and the emoluments of his professorship, made him comparatively a rich man; and he was enabled to indulge himself in the purchase of a villa near Upsal, which became his usual summer retreat during the last fifteen years of his life. His correspondences were greater than any other learned man of the North; and a list of one hundred and fifty persons, of various countries, is mentioned, with whom he held an epistolary commerce. His mind and body at length lingered under a gradual decline. In 1774 the first shock was given by an apoplectic stroke; from which, however, he recovered so far as to resume his public functions. A renewal of it in 1776 irreparably ruined the fabric, and reduced him to a state of absolute childhood, attended with severe sufferings; from which he was released by an easy death on Jan. 10, 1778, in the 71st year of his age.

We shall close this account with some biographical particulars of Charles Linnæus, jun. He was a person whose name would probably never have been heard, had he not been the son of the great Linnæus. He arrived, by dint of habit and application, to some eminence in natural history; but he pursued his studies merely as a task, and without a spark of the ardour and enthusiasm which inspired his father. The coldness and reserve of his temper were augmented by the unworthy treatment which he experienced from his mother, who was one of those unnatural parents who seem actually to have hated their children; and the father was considerably blameable in permitting her injustice, and in even receiving a bias from it. Charles Linnæus, who appears to have been a worthy character, and possessed of the affectionate regard of his intimates, died unmarried in November 1783, in the 42d year of his age, and with him ended the male line of the Swedish naturalist. The widow and some daughters of Linnæus are still living.

INTERESTING OBSERVATIONS ON POLYGAMY.

POLYGAMY, is a plurality of wives or husbands in the possession of one man or woman at the same time; a thing so universally esteemed unlawful, and even unnatural, through Europe, and in all Christian countries, that we have generally reasoned upon this conviction. Both religion and reason appear at first sight at least to condemn it; and, with this view of the subject, mankind in general rest satisfied; but some bolder geniuses have taken the opposite of the question, have cast
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off the prejudices of education, and attempted to shew that polygamy is not unlawful, but that it is just and necessary, and would be a public benefit. Such writers, to use the words of an intelligent critic, "recur to the common subterfuge, of which every setter up of strange gods, and every conscientious troubler of the public peace, have artfully availed themselves to silence the clamour of expostulation. 'Truth! Truth!' is their general cry: and, with this hopeful pretence, prudence and humility, and every amiable and useful virtue, are left behind; while conscience blindly rushes forward to oppose order, insult authority, and overturn the customs of ages."

But notwithstanding these fair pretences, it will, we doubt not, be easy to shew that truth is not upon their side; prudence and delicacy are certainly at open war with them; for Dr. Percival, *Phil. Trans.* vol. lxxvi. part i. p. 163. has very justly observed, that the practice, is brutal, destructive to friendship and moral sentiment, inconsistent with one great end of marriage, the education of children, and subversive of the natural rights of more than half of the species. Besides, it is injurious to population, and therefore never can be countenanced or allowed in a well-regulated state; for, though the number of females in the world may considerably exceed the number of males, yet there are more men capable of propagating their species than women capable of bearing children; and it is a well-known fact, that Armenia, in which a plurality of wives is not allowed, abounds more with inhabitants than any other province of the Turkish empire.

Indeed it appears, that in some countries, where it is allowed, the inhabitants do not take advantage of it. "The Europeans (says M. Niebuhr) are mistaken in thinking the state of marriage so different among the Mussulmans to what it is with Christian nations. I could not discern any such difference in Arabia. The women of that country seem to be as free and as happy as those of Europe can possibly be. Polygamy is permitted, indeed, among Mahometans, and the delicacy of our ladies is shocked at this idea; but the Arabians rarely avail themselves of the privilege of marrying four lawful wives, and entertaining at the same time any number of female slaves. None but rich voluptuaries marry so many wives, and their conduct is blamed by all sober men. Men of sense, indeed, think this privilege rather troublesome than convenient. A husband is by law obliged to treat his wives suitably to their condition, and to dispense his favours among them with perfect equality: but these are duties not a little disagreeable to most Mussulmans; and such modes of luxury are too expensive to the Arabians, who are seldom in easy circumstances. I must, however, except one case; for it sometimes happens that a man marries a number of wives in the way of commercial speculation. I know a mullah, in a town near the Euphrates, who had married four wives, and was supported by the profits of their labour."

Whatever may be said by the author quoted above, it is certain that the Mahometan law ordains a plurality of wives for the express purpose of increasing population; and one would suppose they thought continence a crime against nature. One of their sacred books says, that, "in the day of judgment, the earth on which a man living in celibacy has rested shall rise up against him, and say, What crime have I committed, that my fruits should be enjoyed by a man who was an enemy to human nature? I, who laboured incessantly with the production of living beings." The Mahometans hold that none but those

those of their own religion have a right to have concubines, or to marry several wives; a principle calculated to gain many profelytes to their law. The reason they give for this is rather jocular than serious: "All religions, (say they) have their austerities and their indulgences, which must always go together: the Christian religion allows the use of wine, but only one wife: whilst that of Mahomet allows a plurality of wives, but forbids the use of wine."

Besides, there are those who say that polygamy is founded in nature, and that women may be compared to fields, of which one man is capable of cultivating many, of making them fruitful, &c. and all this without any prejudice to civil society. This was the opinion of the Americans, and of some other nations. All the American Indians are great improvers of nature, whom they will not suffer to lie idle; this accords with the idea they entertain with regard to women.

The Nayres, who are the nobility of the Malabar coast, have a law that permits the Nayre ladies to have many husbands; every one being allowed four. Their houses, which stand single, have as many doors as the lady has husbands. When one of them visits her, he walks round the house, striking with his sabre on his buckler: he then opens his door, and leaves a domestic with his arms in a kind of porch, who serves to inform others that the lady is engaged. It is said, that one day in the week the four doors are all opened, and all her husbands visit her, and dine together with her. Each husband gives a sum of money, or portion, at the time of marriage, and the wife only has the charge of the children. The Nayres, even the Samorin, and the other princes, have no other heirs than the children of their sisters. This law was established, that the Nayres, having no family, might be always ready to march against the enemy. When the nephews are of age to bear arms, they follow their uncles. The name of father is unknown to a Nayre child. He speaks of the husbands of his mother and of his uncles, but never of his father.

Selden has proved, in his *Uxor Hebraica*, that a plurality of wives was allowed of, not only among the Hebrews, but also among all other nations, and in all ages. It is true, the ancient Romans were more severe in their morals, and never practised it, though it was not forbid among them; and Mark Antony is mentioned as the first who took the liberty of having two wives.

From that time it became pretty frequent in the empire till the reigns of Theodosius, Honorius, and Arcadius, who first prohibited it by express law in 393. After this the emperor Valentinian, by an edict, permitted all the subjects of the empire, if they pleased, to marry several wives; nor does it appear from the ecclesiastical history of those times, that the bishops made any opposition to this introduction of polygamy. In effect, there are some, even among the Christian casuists, who do not look on polygamy as in itself criminal. Jurieu observes, that the prohibition of polygamy is a positive law; but from which a man may be exempted by sovereign necessity. Baillet adds, that the example of the patriarchs is a very powerful argument in favour of polygamy; of these arguments we shall speak hereafter.

It has been much disputed among the doctors of the civil law whether polygamy be adultery. In the Roman law it is called *stuprum*, and punished as such, that is, in some cases, capitally. But a smaller punishment is more consistent with the Jewish law, wherein the prohibition of adultery is perpetual, but that of polygamy temporary only.

In Germany, Holland, and Spain, this offence is differently punished. By a constitution of Charles V. it was a capital crime. By the laws of ancient and modern Sweden it is punished with death. In Scotland it is punished as perjury.

In England it is enacted by statute 1 Jac. I. cap. 11. that if any person, being married, do afterwards marry again, the former husband or wife being alive, it is felony, but within the benefit of clergy. The first wife in this case shall not be admitted as an evidence against her husband, because she is the true wife; but the second may, for she is indeed no wife at all; and so *vice versa* of a second husband. This act makes an exception in five cases, in which such second marriage, though in the three first it is void, is, however, no felony.—
 1. Where either party hath been continually abroad for seven years, whether the party in England had notice of the other's being living or not. 2. Where either of the parties hath been absent seven years within this kingdom, and the remaining party hath had no notice of the other's being alive within that time. 3. Where there is a divorce or separation *a mensa et thoro*, by sentence in the ecclesiastical court. 4. Where the first marriage is declared absolutely void by any such sentence, and the parties loosed *a vinculo*. Or, 5. Where either of the parties was under the age of consent at the time of the first marriage; for in such case the first marriage was voidable by the disagreement of either party, which this second marriage very clearly amounts to. But, if at the age of consent the parties had agreed to the marriage, which completes the contract, and is indeed the real marriage, and afterwards one of them should marry again, Judge Blackstone apprehends that such second marriage would be within the reason and penalties of the act.

Bernardus Ochinus, general of the order of Capuchins, and afterwards a Protestant, published, about the middle of the 16th century, Dialogues in favour of Polygamy, which were answered by Theodore Beza. And about the conclusion of the last century we had at London an artful treatise published in behalf of a plurality of wives, under the title of *Polygamia Triumphatrix*; the author whereof assumes the name of *Theophilus Aletheus*, but his true name was *Lyserus*. He was a native of Saxony. It has been answered by several.

A new argument in favour of polygamy has been adduced by Mr. Bruce, on this principle, that in some parts of the world the proportion of female children is must greater than that of males. "From a diligent enquiry (says he) into the south and scripture part of Mesopotamia, Armenia, and Syria, from Mouful and Nineveh to Aleppo and Antioch, I find the proportion to be fully two women to one man. There is indeed a fraction over, but it is not a considerable one. From Latikea, Laodicea ad mare, down the coast of Syria to Sidon, the number is nearly three, or two and three-fourths, to one man. Through the Holy Land, the country called Horan, in the Isthmus of Suez, and the parts of the Delta unfrequented by strangers, it is something less than three. But from Suez to the Straits of Babelmandel, which contains the three Arabias, the proportion is fully four women to one man; which I have reason to think holds as the line, and 30° beyond it. The Iman of Sama was not an old man when I was in Arabia Felix in 1769, but he had eighty-eight children then alive, of whom fourteen only were sons. The priest of the Nile had seventy and odd children; of whom, as I remember, above fifty were daughters.

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"It may be objected that Dr. Arbuthnot, in quoting the bills of mortality for twenty years, gave the most unexceptionable grounds for his opinion; and that my single assertion of what happens in a foreign country, without farther foundation, cannot be admitted as equivalent testimony: and I am ready to admit this objection, as there are no bills of mortality in any of these countries. I shall therefore say in what manner I attained the knowledge which I have just mentioned. Whenever I went into a town, village, or inhabited place, dwelt long in a mountain, or travelled journeys with any set of people, I always made it my business to inquire how many children they had, or their fathers, their next neighbours or acquaintance. I then asked my landlord at Sidon, suppose him a weaver, how many children he has had? He tells me how many sons and how many daughters. The next I ask is a tailor, a smith, &c. in short every man who is not a stranger, from whom I can get the proper information. I say, therefore, that a medium of both sexes, arising from three or four hundred families, indiscriminately taken, shall be the proportion in which one differs from the other; and this, I am confident, will give the result to be three women to one man in 50° of the 90° under every meridian of the globe."

Our author corroborates this argument by supposing that Mahomet perceived this disproportion, and that upon it he founded his institution allowing one man to have four wives. "With this view, he enacted, or rather revived, the law which gave liberty to every individual to marry four wives, each of whom was to be equal in rank and honour, without any preference but what the predilection of the husband gave her."

Having thus established, as he supposes, the necessity of polygamy in the East, Mr. Bruce proceeds to consider whether there are not some other reasons why it should not be practised in Britain farther than the mere equality in numbers of the sexes to one another. This reason he finds in the difference between the constitutions of the Europeans and eastern nations. "Women in England (says he) are capable of child-bearing at fourteen; let the other term be forty-eight, when they bear no more; thirty-four years therefore an Englishwoman bears children. At the age of fourteen or fifteen they are objects of our love; they are endeared by bearing us children after that time; and none, I hope, will pretend, that at forty-eight and fifty an Englishwoman is not an agreeable companion. The Arab, on the other hand, if she begins to bear children at eleven, seldom or never has a child after twenty. The time, then, of her child-bearing is nine years; and four women, taken altogether, have then the term thirty-six. So that the Englishwoman that bears children thirty-four years has only two years less than the term enjoyed by the four women whom Mahomet has allowed; and if it be granted that an English wife may bear at fifty, the terms are equal. But there are other grievous differences. An Arabian girl, at eleven years old, by her youth and beauty becomes the object of man's desire; being an infant, however, in understanding, she is not a rational companion for him. A man marries there, say at twenty, and before he is thirty, his wife, improved as a companion, ceases to be an object of his desires and a mother of children; so that all the best and most vigorous of his days are spent with a woman he cannot love; and with her he would be destined to live forty or forty-five years, without comfort to himself, by increase of family, or utility to the public. Thereasons,

then against polygamy, which subsist in England, do not by any means subsist in Arabia; and, that being the case, it would be unworthy of the wisdom of God, and an unevenness in his ways, which we shall never see, to subject two nations under such different circumstances absolutely to the same observances."

To all this argumentation, however, it may be replied, that, whatever we may now suppose to be the constitution of nature in the warmer parts of the globe, it certainly was different at the beginning. We cannot indeed ascertain the exact position of the Garden of Eden, but it is with reason supposed not to have been far from the ancient seat of Babylon. In that country, therefore, where Mr. Bruce contends that four women are necessary to the comfort of one man, it pleased God to grant only one to the first man; and that, too, when there was more occasion for population than ever there has been since, because the whole earth was to be peopled from a single pair. Matters were not altered at the flood, for Noah had but one wife. And this is the very argument used by our Saviour himself, when speaking of divorce without any sufficient cause, and then marrying another woman, which is a species of polygamy.—Again, with respect to the alleged multiplicity of females in the eastern part of the world, it is by no means probable that the calculations of Mr. Bruce or any other person can be admitted in this case. History mentions no such thing in any nation; and, considering the vast destruction among the male part of the human species more than of the females by war and other accidents, we may safely say, that, if four female children were born for every single male, there would in such countries be five or six grown-up women to every man; a proportion which we may venture to affirm does not, nor ever did, exist any where in the world. That it was not so in former times we can only judge from the particular examples recorded in history, and these are but few. We read in the Greek history, indeed, of the fifty daughters of Danaus; but these were matched by as many sons of another man. Job had only one wife, yet had seven sons and but three daughters. Jacob had two wives, who bore twelve sons, and only one daughter. Abraham had only one child by his first wife, and that was a son. By his second wife Keturah he had six sons; and, considering his advanced age at the time he married her, it is by no means probable that he could have twenty-four daughters; nay, if, as Mr. Bruce tells us, the women in the eastern countries bear children only for nine years, it was impossible she could have so many. Gideon, who had many wives, had no fewer than seventy sons by these wives, and even his concubine had a son; so that, if all these women had produced according to Mr. Bruce's proportion of nearly three females to one male, he must have had almost two hundred and eighty-four children; a better family than any of Mr. Bruce's eastern acquaintances can probably boast of.

With regard to this subject, however, it must be observed, that the procreation of male or female children depends in some degree on the health and vigour of the parents. It is by no means improbable, therefore, that the eastern voluptuaries, whose constitutions are debilitated by their excesses, may have many more female than male children born to them. The women themselves, by premature enjoyment, will also be inclined to produce females instead of males; but neither of these circumstances can prove this to be an original law of nature. Something like this may be gathered from sacred history.

Gideon,

Gideon, above-mentioned, who was a hardy and active warrior, had many sons. The same was the case with David, who led an active and laborious life; while Solomon, who was a voluptuary, had only one son, notwithstanding his multitude of wives.

The most singular defence of polygamy that has appeared in modern times is by the Rev. Mr. Madan, who published a treatise, artfully vindicating and strongly recommending it, under the title of *Thelyphthora*; or, *A Treatise on Female Ruin, in its Causes, Effects, Consequences, Prevention, and Remedy*, &c. Marriage, according to this writer, simply and wholly consists in the act of personal union, or *actus coitus*. Adultery, he says, is never used in the sacred writings but to denote the defilement of a betrothed or married woman, and to this sense he restricts the use of the term; so that a married man, in his opinion, is no adulterer, if his commerce with the sex be confined to single women, who are under no obligations by espousals or marriage to other men: but, on the other hand, the woman who should dare to have even but once an intrigue with any other man besides her husband, (let him have as many wives as Solomon,) would, *ipso facto*, be an adulteress, and ought, together with her gallant, to be punished with immediate death. This, he boldly says, is the law of God: and on this foundation he limits the privilege of polygamy to the man; in support of which he refers to the polygamous connections of the patriarchs and saints of the Old Testament, and infers the lawfulness of their practice from the blessings which attended it, and the laws which were instituted to regulate and superintend it. He contends for the lawfulness of Christians having, like the ancient Jews, more wives than one; and labours much to reconcile the genius of the evangelical dispensation to an arrangement of this sort: With this view he asserts, that there is not one text in the New Testament that even hints at the criminality of a polygamous connection; and he would infer from St. Paul's direction, that bishops and deacons should have but one wife, that it was lawful for laymen to have more. Christ, he says, was not the giver of a new law; but the business of marriage, polygamy, &c. had been settled before his appearance in the world, by an authority which could not be revoked. Besides, this writer not only thinks polygamy lawful in a religious, but advantageous in a civil, light, and highly politic in a domestic view.

In defence of his notion of marriage, which, he says, consists in the union of man and woman as one body, the effects of which in the sight of God no outward forms or ceremonies of man's invention can add to or detract from, he grounds his principal argument on the Hebrew words made use of in Gen. ii. 24. to express the primitive institution of marriage. Our translation, "shall cleave to his wife," doth not, he says convey the idea of the Hebrew, which is literally, as Montanus renders the words, "shall be joined or cemented *in* his woman, and they shall become (*i. e.* by this union) one flesh." But on this criticism it is well remarked, that both the Hebrew and Greek terms mean simply and literally attachment or adherence; and are evidently made use of in the sacred writings to express the whole scope of conjugal fidelity and duty, though he would restrain them to the grosser part of it.

With respect to the Mosaic law, for which Mr. Madan is a warm advocate, it was certainly a local and temporary institution, adapted

to the ends for which it was appointed, and admirably calculated, in its relation to marriage, to maintain and perpetuate the separation of the Jewish people from the Gentiles. In attempting to depreciate the outward forms of marriage, this writer would make his readers believe, that, because none are explicitly described, therefore none existed; and consequently that they are the superfluous ordinances of human policy. But it is evident, from comparing Ruth iv. 10, 13. with Tobit vii. 13. 14. and from the case of Dinah, related Gen. xxxiv. that some forms were deemed essential to an honourable alliance by the patriarchs and saints under the Old Testament, exclusive of the carnal knowledge of each other's persons. It is also evident in the case of the woman of Samaria, whose connections with a man not her husband is mentioned in John iv. that something besides cohabitation is necessary to constitute marriage in the sight of God.

Having stated his notion of marriage, he urges, in defence of polygamy, that, notwithstanding the seventh commandment, it was allowed by God himself, who made laws for the regulation of it, wrought miracles in support of it by making the barren woman fruitful, and declared the issue legitimate to all intents and purposes. God's allowance of polygamy is argued from Exod. xxi. 10. and particularly from Deut. xxi. 15. which, he says, amounts to a demonstration. This passage, however, at the utmost, only presupposes that the practice might have existence among so hard-hearted and fickle a people as the Jews; and therefore wisely provides against some of its more unjust and pernicious consequences, such as tended to affect the right and privileges of heirship. Laws enacted to regulate it cannot be fairly urged in proof of its lawfulness on the author's own hypothesis; because laws were also made to regulate divorce, which Mr. Madan condemns as absolutely unlawful, except in cases of adultery. Besides, it is more probable that the "hated wife" had been dismissed by a bill of divorcement, than that she was retained by her husband: and moreover, it is not certain but that the two wives, so far from living with the same husband at the same time, might be dead; for the words may be rendered thus, "if there *should have been* to a man two wives, &c." The words expressing the original institution of marriage, Gen. ii. 24. compared with Mat. xix. 4, 5, 8. afford insuperable objections against Mr. Madan's doctrine of polygamy.

If we appeal on this subject from the authority of Scripture to the writings of the earliest fathers in the Christian church, there is not to be found the faintest trace of any thing resembling a testimony to the lawfulness of polygamy; on the contrary, many passages occur, in which the practice of it is strongly and explicitly condemned.

In a word, when we reflect that the primitive institution of marriage limited it to one man and one woman; that this institution was adhered to by Noah and his sons, amidst the degeneracy of the age in which they lived, and in spite of the examples of polygamy which the accursed race of Cain had introduced; when we consider how very few (comparatively speaking) the examples of this practice were among the faithful; how much it brought its own punishment with it; and how dubious and equivocal those passages are in which it appears to have the sanction of divine approbation; when to these reflections we add another, respecting the limited views and temporary nature of the more ancient dispensations and institutions of religion—

religion—how often the imperfections and even vices of the patriarchs and fathers, in old time, are recorded, without any express notification of their criminality—how much is said to be commanded, which our reverence for the scriptures will only suffer us to suppose, were, for wise ends, permitted—how frequently the messengers of heaven adapted themselves to the genius of the people to whom they were sent, and the circumstances of the times in which they lived :—above all, when we consider the purity, equity, and benevolence, of the Christian law ; the explicit declarations of our Saviour, and his apostle St. Paul, respecting the institution of marriage, its design and limitation ;—when we reflect, too, on the testimony of the most ancient authors, who could not possibly be ignorant of the general and common practice of the apostolic church ; and, finally, when to these considerations we add those which are founded on justice to the female sex, and all the regulations of domestic economy and national policy—we must wholly condemn the revival of polygamy ; and thus bear our honest testimony against the leading design of this dangerous and ill-advised publication.

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OF ABSORPTION AND CIRCULATION.

WHEN the food has undergone the first preparation, which is called digestion, and the chyle is formed in the alimentary canal or sap-vessels, it is thence taken up by means of absorption for the use of the system. From the vessels it passes into the whole cellular tissue, composed of vesicles, and closely interwoven with all the vascular part of the plant. From the vesicles or utricle of the cellular tissue it enters the *vasa propria* and glands, which contain and prepare the fluids and secretions peculiar to the species.

In the animal economy it was always supposed that the chyle was absorbed by the ramifications of the red veins spreading on the gut, till the year 1622, when Asellius an Italian discovered the lacteals running on the mesentery of a living dog, and printed his account of them in 1627. As he had not traced their course very far, he naturally thought that they went to the liver, which was then imagined to be the organ of sanguification. This opinion, with respect to the place where they entered the veins, continued to be general till 1651, when Pecquet in France published his account of the thoracic duct. With great candour this author acknowledged, that he had been led to make the discovery by observing a whitish fluid mixed with the blood in the right auricle of the heart of a dog, which kind of animal it had been customary to dissect alive since the time of Asellius. " This practice of opening living animals furnished likewise occasions (says Dr. Hunter) of discovering the lymphatics. This good fortune fell to the lot of Rudbec first, a young Swedish anatomist, and then to Thomas Bartholine a Danish anatomist, who was the first who appeared in print upon the lymphatics. His book came out in 1653, that is, two years after that of Pecquet ; and then it was evident that they had been seen before by Dr. Highmore and others, who had mistaken them for lacteals ; but (adds Dr. Hunter) none of the anatomists of those times could make out the origin of the lymphatics, and none of the physiologists could give a satisfactory

satisfactory account of their use." He had not known that Glisson, who wrote in 1654, has ascribed to these vessels the office of carrying the lubricating lymph from the several cavities back into the blood; and that Frederic Hoffman has expressed the doctrine of their being absorbents very explicitly.

It was on the 19th of June 1664 that Swammerdam discovered the valves of these vessels; and Ruysch, who had seen them, perhaps very nearly about that time, first gave an account of them in a small treatise which he published at the Hague in 1665.

The best mode of demonstrating the lymphatics we probably owe to the celebrated Nuck, who, as a specimen of that complete system of Lymphography which he meant to publish, printed in 1691 his *Adenography*, or description of the glands. In this treatise he not only tells us how he brought them into view, but in his plates represents many of them as filled with his new mercurial injections; a happy invention, which perhaps was suggested by remarking the extreme subtilty of mercury when employed in the cure of venereal infection.

A method by which he inflated these vessels led him to suppose that they took their origin from veins or arteries, either immediately or through the intervention of some follicles. The celebrity of his name procured credit to this mistake; and notwithstanding the sounder opinion of Glisson, of Hoffman, and some others, the old notion that the veins performed the office of absorbents came so far down as the great names of Haller and of Meckel. The arguments, however, by which it was supported are shewn now, and particularly by those of the Hunterian school, to have been injections that were not skilful, observations that were not accurate, and conclusions that were not logical; while the boasted assertion that birds and fishes were without lacteals and without lymphatics, has been disproved by the fortunate discoveries of Mr. Hewson and Dr. Monro. Excepting, therefore, in the penis and placenta, and in those animals whose veins may be injected from the gravid uterus, the lymphatics seem to perform the whole business of absorption. They contain a fluid that is coagulable like the lymph of the blood, and are called valvular to distinguish them from the arteries that do not admit the red globules. They derive their origin from the cellular membrane, from the different cavities, and from the surface. Some authors say that they have seen them in the brain, and these Mascagni has ventured even to describe in prints. That some indeed may exist in the brain, has not been denied; but to believe that they have been found, and to trust assertions which are not countenanced by the observations of skilful anatomists, requires a faith which for our part we do not pretend to. Both they and the lacteals derive their name from the colour of the fluids which they contain. They both empty themselves into the veins; but most of the lymphatics in the human subject, and all the lacteals, first unite in the thoracic duct, which near the heart leads into the course of the CIRCULATION.

After part of the food is converted into chyle, and this chyle absorbed by the lacteals, and brought into the course of the circulation, it remains to be distributed to all the different parts of the system. On this account, Hippocrates speaks of the usual and constant motion of the blood, of the veins and arteries as the fountains of human nature,

nature, as the rivers that water the whole body, and which if they be dried up man dies. He says that the blood-vessels are for this reason every where dispersed through the whole body; that they give spirits, moisture, and motion; that they all spring from one; and that this one has no beginning and no end, for where there is a circle there is no beginning. In such language was the prince of physicians accustomed to express his vague ideas of a circulation; for so far was he from having acquired accurate conceptions on this subject, that, when he saw the motions of the heart, he believed that the auricles were two bellowses to draw in air, and to ventilate the blood.

When after his time anatomy came to be more studied, the notions of the ancients respecting the blood were better defined; and, however chimerical they may seem to us, they were partly derived from dissection and experiment. On opening dead bodies, they found that the arteries were almost empty, and that very nearly the whole of the blood was collected in the veins, and in the right auricle and ventricle of the heart. They therefore concluded that the right ventricle was a sort of laboratory; that it attracted the blood from the cavæ, by some operation rendered it fit for the purpose of nutrition, and then returned it by the way it came. From the almost empty state of the arteries, they were led to suppose that the right ventricle prepared air, and that this air was conveyed by the arteries to temper the heat of the several parts to which the branches of the veins were distributed.

To this last notion entertained by Erasistratus, Galen added an important discovery. By certain experiments, he proved that the arteries contained blood as well as the veins. But this discovery was the occasion of some embarrassment. How was the blood to get from the right to the left ventricle? To solve the difficulty in which his new discovery had involved him, he supposed that the branches of the veins and arteries anastomosed; that when the blood was carried to the lungs by the pulmonary vein, it was partly prevented by the valves from returning; that therefore during the contraction of the thorax it passed through the small inosculating branches to the pulmonary vein, and was thence conveyed along with air to the left ventricle to flow in the aorta. This opinion, so agreeable to fact, unfortunately afterwards gave place to another that was the result of mere speculation.—This notion was, that the left ventricle received air by the pulmonary vein, and that all its blood was derived through pores in the septum of the heart.

The passage through the septum being once suggested, and happening to be more easily conceived than one through the lungs, it was generally supposed the only one for a number of centuries; and supported likewise, as it was thought, by Galen's authority, it was deemed blasphemy in the schools of medicine to talk of another. In 1543, however, Vesalius having published his immortal work upon the structure of the human body, and given his reasons in the sixth book why he ventured to dissent from Galen, he particularly shewed how it was impossible that the blood could pass through the septum of the heart. His reasoning roused the attention of anatomists; and every one grew eager to discover the real passage which the blood must take in going from the right to the left ventricle. The discovery of this fell first to the lot of Michael Servede, a

Spanish physician, who published his opinion, and revived the old doctrine of Galen, in 1553. But his opinion did not spread at the time; the book in which it made its appearance contained heresy, and was therefore destroyed by public authority. Fortunately, however, the same discovery was again made by Realduſ Columbus, profeſſor of anatomy firſt at Padua and afterwards at Rome, who printed his account of it in 1559. Many others who were engaged in the ſame reſearch were equally ſucceſſful, and Andreas Cæſalpinus even ſingularly lucky. It appears by his peripatetic queſtions printed at Venice in 1571, and reprinted there with his medical queſtions in 1593, that he knew not only the ſmaller circulation, but had obſerved that there were times when the blood flowed from the branches of the veins towards their trunks, and that veins ſwelled between their ligature and the extremities, and not between the ligature and the heart. From theſe obſervations, he neceſſarily inferred that the veins and arteries anastoſoſed; and having alſo contemplated the nature of all the valves which were then known, and had been known ſince the days of Galen, he ventured to aſſert the blood could not return by the arteries to the left ventricle. One ſhould imagine that from ſuch concluſions he muſt have diſcovered the true circulation; but he did not. Being a zealous peripatetic, he thought himſelf bound to maintain with Ariſtotle that the blood flowed, like the tides of Euripus, backwards and forwards in the ſame channel; and therefore ſuppoſed that it flowed from the arteries into the veins in the time of ſleep, and from the veins back into the arteries in the time of waking. The greater circulation, ſo far as we can learn, was not even dreamed of by this writer. A farther ſtep was yet to be made towards its diſcovery; and this was reſerved for another profeſſor of the Paduan ſchool.

In 1574, Hieronymus Fabricius, while he was ſeeking for a cauſe to explain the varicoſe ſwellings of ſome veins which had ariſen from friction and ligature, he to his great joy and aſtoniſhment diſcovered their valves in one of his diſſections: and here again the true theory of circulation ſeemed almoſt unavoidable. Yet whoever reads the ſmall treatiſe *De Venarum Oſtiolis*, firſt printed by Fabricius in 1603, will ſoon perceive that he was as far from entertaining a juſt notion of the circulation as his predeceſſors. Notwithſtanding all that he ſaw, he ſtill was of opinion that the blood flowed from the heart to the extremities even in the veins. He thought that the valves were intended by nature only to check and moderate its force. He calls them an inſtance of admirable wiſdom, and miſtakes his own aukward conjecture for one of the deſigns of infinite intelligence. In another reſpect, it muſt be confeſſed that he bore no inconfiderable ſhare in promoting the diſcovery of the circulation. By writing on the valves, the formation of the fœtus, and the chick in ovo, he directed the attention of his pupil Harvey to thoſe ſubjects where it was likely that the motion of the blood would frequently occur.

Harvey was born at Folkeſtone in Kent in 1578, completed his ſtudies at the univerſity of Cambridge, went to Padua, and was there admitted to the degree of doctor, with unuſual marks of approbation, in 1602. He examined the valves with more accuracy than his maſter Fabricius; and explained their uſe in a treatiſe which he published ſome time after. It is uncertain when he firſt conceived his celebrated doctrine of circulation; but about the year 1616 he taught

taught it in his lectures, and printed it in 1628. He was the first author who spoke consistently of the motion of the blood, and who, unbiassed by the doctrine of the ancients, drew rational conclusions from his experiments and observations. His books present us with many indications of a great mind, acute discernment, unwearied application, original remark, bold inquiry, and a clear, forcible, and manly reasoning; and every one who considers the surprise which his doctrine occasioned among the anatomists of those days, the strong opposition that it met with from some, and those numerous and powerful prejudices which it had to encounter from the sanction of time and of great names, must allow it was new, and that the author has from its importance a title to rank in the first class of eminent discoverers ancient or modern.

His discovery shewed, that in most animals the blood circulates in arteries and veins, and through the medium of one, two, or of more, hearts; that in arteries it moves from the trunk to the branches; and that, meeting there with the branches of veins, it returns in a languid stream to the heart; that the heart communicates a new impulse; that it drives it on to the trunk of the arteries; and that the arteries, by the thickness of their coats, exerting a force, push it onwards again into the veins.

In every part of this circulating course, there are valves situated where it is necessary; they are meant to prevent the return of the blood; they are at the beginnings of the great arteries, and are found in different places of the veins where their feeble action requires to be assisted.

The veins, before they enter the heart, generally expand into a thin muscular sac, which is called the auricle. It receives the blood while the heart is contracting; and when the heart admits of dilatation, contracts itself, and throws the blood into the ventricle.

We have here called the ventricle a heart; though what is usually meant by the heart be a ventricle and auricle; or sometimes a ventricle and two auricles, where the veins approach in different directions, and, without bending to meet one another, expand at two different places. Two hearts are sometimes united, so as in appearance to form but one.

From our having mentioned more than one heart, it will be supposed that the modes of circulation are various. In some animals the heart throws its blood to the remotest parts of the system; in other animals it throws its blood only into the respiratory organs: from these organs it is collected by the branches of veins; and these branches, uniting in a trunk, convey it to an artery, which renews the impulse, and acts as a heart. In a third set of animals, the blood from the respiratory organs is carried by the veins to another heart; and this second heart, united in the same capsule with the first, distributes the blood by the channel of its arteries to the several parts. In the human foetus, and the foetus of those animals which have two hearts, a part of the blood, without taking the passage through the lungs, proceeds directly from auricle to auricle. In amphibious animals, the auricular passage continues open during their life, and is employed, when the breathing ceases, under the water. In many insects, a number of hearts, or expansions which answer the purpose of hearts, are placed at intervals on the circulating course; and each renews the impulse of the former, where the mo-

mentum of the blood fails. In the *sepia loligo*, the two separate parts of the gills are each supplied by a heart of its own : the blood from both is collected into one ; which, by two arteries opening at two different parts, send it at once to the opposite extremities. In numbers of animals, the heart, like the stomach, is in the extremity opposite to the head.

After the discovery of the circulation, the most interesting object with anatomists was to demonstrate it in a clear, satisfactory, and easy, manner. Harvey, to shew it with every advantage that he could think of, was obliged to open animals alive : but, whether the animals were dead or alive, the larger branches of the veins and arteries were only to be seen, and even these but in certain cases, when they happened occasionally to be full of blood. That admirable method, which is now observed in demonstrating the course of the circulation, we owe to the great anatomists of Holland who flourished in the last century. About 1664, Regnier de Graaf invented the syringe, which is now used ; and, accompanied with a print, published an account of it in 1669. His injection was usually a thin fluid of a blue, green, or some other, colour ; this injection, transfused through the vessels, allowed them to collapse by its general diffusion, and broke out through the first opening that happened in its way. A fluid which hardened after being injected, and which preserved the vessels distended, was a happier contrivance. This at first was either melted tallow or wax, of a colour suiting the taste of the anatomist. So early as the year 1667, the celebrated Swammerdam injected the vessels running on the uterus with ceraceous matter ; and, jealous lest another should claim the merit of such an invention, he transmitted preparations, accompanied with plates, and with a full account of his method, to the Royal Society of London in 1672. Soon after, his friend Ruysch acquired such skill in the art of injecting, that he has not been surpassed by any since his time. He discovered vessels in many parts where they were not supposed to have had an existence ; and, contrary to the opinion of the great Malpighi, he shewed that even many of the glands were entirely vascular ; and that what had been supposed excretory ducts, deriving their origin from some follicle, were but terminations of arteries continued : yet even Ruysch could not exhibit in all cases the course of the vessels so well as we do now. Another discovery was yet to be made for demonstrating their small capillary branches running through a part. This was reserved for the very ingenious Dr. Nicholls of London ; who invented the method of corroding the fleshy parts with a menstruum, and leaving the wax, as it was moulded by the vessels, entire.

From these researches, which evince circulation to be a function so general among animals, some are disposed to think it takes place in all living bodies. But notwithstanding the fashionable language of circulating fluids, of veins, arteries, and even of valves, in the vegetable structure ; yet nothing performing the office of a heart, and nothing that seems to conduct fluids in a circular course, has been found in plants. In the vegetable kingdom, the chyle is distributed to all the parts from the numerous vessels which convey the sap : and these vessels, being fitted by their structure to carry the sap either downwards or upwards, from the branches to the roots, or from the roots to the branches, is the reason why plants inverted in the ground,

ground will send forth roots from the place of their branches, and send forth branches from the place of their roots. Even a similar distribution of the chyle takes place in some animals. In the human *tænia*, in the *fasciola hepatica* of sheep, and in most polypes, the chyle, without a circulating system, is conveyed directly to the different parts from the alimentary canal. The taste for circulation may at last subside. Till the business of absorption from the intestines was, of late, fully secured to the lacteals, we were wont to have also learned dissertations upon a circular motion of the bile. The jaunt which it took was not very cleanly; but it was social: it went with the fœces down the intestines, and returned with the blood in the meseraic veins.

Besides the circulation, another circumstance respecting the blood, which sometimes has engaged the thoughts of physiologists, is the colour which it has in most animals. The late Mr. Hewson was of opinion, that the lymphatics, with the spleen and the thymus, contributed greatly to the formation of the red globules. He was seemingly led to entertain this opinion from that attention to the lymphatics which made him ascribe much to their power, and from seeing red particles in the absorbents which rise from the splenic and the thymic gland. His reasoning, however, though very ingenious, is not conclusive. The celebrated Nuck, who had often observed a reddish fluid in the lymphatics, assures us, without any hypothesis, that such an appearance was always preternatural; and was either occasioned by a scarcity of lymph, or by some irregular and too much accelerated motion of the blood.

It is well known that the blood receives its vermilion colour in passing through the lungs; that animals with lungs have the blood redder than those which are seemingly without that organ; and that the colour, as well as the heat, is in proportion to the extent and perfection of the lungs. It has also been observed, that oxygenous gas is absorbed in respiration; and been proved by experiment, that the red globules of the blood, and the red only, contain iron. It thence would appear, that the colour is owing to iron calcined by the pure air, and reduced to the state of a red oxid. From this manner of conceiving the phenomena, says Chaptal, we may perceive why animal substances are so advantageous in assisting and facilitating the red dye.

A great variety of experiments have shewn how much the colour and consistence of the blood are altered by the mere action of the vessels; and this discovery has enabled us to conjecture with more certainty than we did formerly, why in infants and phlegmatic persons the blood is paler, in the choleric more yellow, and in the sanguine of vermilion red. It explains likewise, in some measure, why the blood varies in the same individual, not only with regard to the state of health, but likewise at the same instant; and why the blood which circulates through the veins has not the same intensity of colour, nor the same consistence, as that of the arteries; and why the blood which flows through the organs of the breast differs from that which passes languidly through the viscera of the lower belly. This power of the vessels over the blood will bring us also to the true cause why the vessels vary in the density of their coats and in their diameters; why they are sometimes convoluted in a gland;

why they sometimes deposit their contents in a follicle; why they are sometimes of a spiral form; why the branches strike off at various angles; why they are variously anastomosed; why they sometimes carry the blood with dispatch and sometimes slowly through a thousand windings. By those means their action is varied, and the blood prepared in numerous ways to answer the ends of nutrition and secretion.

CHINESE METHOD OF PREPARING TEA.

TEA grows on a small shrub, the leaves of which are collected twice or thrice every year. Those who collect the leaves three times a-year begin at the new moon which precedes the vernal equinox, whether it falls in the end of February or the beginning of March. At that period most of the leaves are perfectly green, and hardly full expanded: but these small and tender leaves are accounted the best of all; they are scarce, and exceedingly dear.

The second crop, or the first for those who collect the leaves only twice a-year, is gathered about the end of March, or the beginning of April. Part of the leaves have then attained to maturity; and, though the other part have acquired only half their size, they are both collected without any distinction.

The third, or the second for some, and last crop, is more abundant, and is collected about the end of April, or the beginning of May, when the leaves have attained to their full growth, either in size or number. There are some people who neglect the two first crops, and who confine themselves entirely to this; the leaves of which are selected with great care, and distributed into classes according to their size and goodness. Tea ought to be rejected as of a bad quality, when old, and as it were withered, leaves are found amongst it: which may be easily known, by infusing a little of it in water; for then the leaves dilate, and return to their natural state.

The leaves of the tea-shrub are oblong, sharp-pointed, indented on the edges, and of a very beautiful green colour. The flower is composed of five white petals disposed in the form of a rose, and is succeeded by a pod of the size of a filberd, containing two or three small green seeds, which are wrinkled, and have a disagreeable taste. Its root is fibrous, and spreads itself out near the superficies of the ground.

This shrub grows equally well in a rich as in a poor soil. It is to be found all over China; but there are certain places where the tea is of a better quality than in others. Some people give the preference to the tea of Japan; but we have reason to doubt whether there is any real difference.

The manner of preparing tea is very simple: when the leaves are collected, they are exposed to the steam of boiling water, in order to soften them; and they are then spread out upon metal plates, and placed over a moderate fire, where they acquire that shrivelled appearance which they have when brought to Europe.

In China, there are only two kinds of the tea-shrub; but the Chinese, by their industry, have considerably multiplied each of them. If there are, therefore, large quantities of tea in that country, which is excessively dear, there is some also very common,
and

and sold at a low rate. The Chinese, however, are very fond of good tea, and take as much pains to procure it of an excellent quality as the Europeans do to procure excellent wine.

BOHEA TEA.—The Chinese name of this tea is *you-y tcha*, that is to say, tea of the kind called *you-y*. It takes its name from a mountain in the province of Fokien.

There are three kinds of this tea; the first of which, called common bohea, grows at the bottom of the mountain; the second, called *cong-fou*, or *camphou*, grows at the top; and the third, named *saot-chaon*, grows in the middle. These names are in England corrupted into *congo* and *fouchong*.

Bohea teas, in general, ought to be dry, and heavy in the hand: this is a sign that the leaves have been full and juicy. When infused, they ought to communicate to the water a yellow colour, inclining a little to green, which indicates that they are fresh; for old tea produces a red colour. Care must be taken, above all, to avoid red leaves, and to chuse such as are large and entire. This also is a sign of freshness; for the longer tea is kept, the more it is shaken, which breaks the leaves, and mixes them with a great deal of dust. It sometimes happens, however, that the tea-dust is owing to the manner in which it is put into the box, as the Chinese tread upon it with their feet, to make it hold a larger quantity. The leaves of the *cong-fou* and *saot-chaon* teas ought to have a beautiful black shining tint, to be large and weighty, and to communicate to water a very bright colour, and a mild taste.

The pekao is a particular kind of tea-shrub, the leaves of which are all black on the one side, and all white on the other. As the real pekao tea is very scarce and dear, the Chinese adulterate it, by mixing with it some of the small half-grown leaves, as yet white, which grow on the top of the common bohea-tea tree. This changes the quality of the pekao; for these leaves being scarcely formed, can have very little sap or flavour.

GREEN TEA.—Green teas do not grow in the same places as the bohea tea. They are brought from the province of Nankin, and are distinguished into three sorts. The first is known under the name of *songlo* tea, but oftener under that of *green toukay*; the second is called *bin* tea, and the third *hayssuen* tea. There are also some other kinds; but the greater part of them are unknown or of little importance to foreigners. The *songlo* and *hayssuen* teas come from the same shrub. Their only difference is in the manner of their being prepared.

Bin tea grows on a different shrub, the leaves of which are thicker and larger than those of other kinds.

All these teas ought to have a green leaden tint: the older they are, the leaves become more yellow, which is a very great fault. They ought also to have a burnt or scorched smell, not too strong, but agreeable: for, when they have been long kept, they have a fishy smell, somewhat like that of pilchards. The French wish to find in green teas, and particularly in *songlo* and *imperial*, an odour similar to that of soap.

In these different kinds of tea, there is a particular distinction to be made, as they are generally classed into one, two, or three, kinds, according to the periods at which they were gathered.

OF THE INVENTION AND EFFECTS OF GUNPOWDER.

GUNPOWDER is a composition of saltpetre, sulphur, and charcoal, mixed together, and usually granulated; which easily takes fire, and, when fired, rarefies or expands with great vehemence, by means of its elastic force. It is to this powder we owe all the action and effect of guns, ordnance, &c. so that the modern military art, fortification, &c. in a great measure depend thereon.

In 1320, Bartholomew Schwartz, a German monk, is commonly said to have invented gunpowder, though it is certainly known that this composition is described by Bacon in some of his treatises long before the time of Schwartz. The following is said to have been the manner in which Schwartz invented gunpowder. Having pounded the materials for it in a mortar, which he afterwards covered with a stone, a spark of fire accidentally fell into the mortar and set the mixture on fire; upon which the explosion blew the stone to a considerable distance. Hence it is probable that Schwartz might be taught the simplest method of applying it in war; for Bacon seems rather to have conceived the manner of using it to be by the violent effort of the flame unconfined, and which is indeed capable of producing astonishing effects.

Dr. Shaw's receipt for making gunpowder is as follows: Take four ounces of saltpetre, an ounce of brimstone, and six drachms of small-coal: reduce these to a fine powder, and continue beating them for some time in a stone mortar with a wooden pestle, wetting the mixture between whiles with water, so as to form the whole into an uniform paste, which is reduced to grains by passing it through a wire-sieve fit for the purpose; and in this form, being carefully dried, it becomes the common gunpowder. For greater quantities mills are usually provided, by means of which more work may be performed in one day than a man can do in a hundred.

The nitre or saltpetre is refined thus: Dissolve four pounds of rough nitre as it comes to us from the Indies, by boiling it in as much water as will commodiously suffice for that purpose: then let it shoot for two or three days in a covered vessel of earth with sticks laid across for the crystals to adhere to. These crystals, being taken out, are drained and dried in the open air. In order to reduce this salt to powder, they dissolve a large quantity of it in as small a proportion of water as possible; then keep it constantly stirring over the fire till the water exhales and a white dry powder is left behind. In order to purify the brimstone employed, they dissolve it with a very gentle heat; then scum and pass it through a double strainer. If the brimstone should happen to take fire in the melting, they have an iron cover that fits on close to the melting-vessel, and damps the flame. The brimstone is judged to be sufficiently refined if it melts, without yielding any fetid odour, between two hot iron plates, into a kind of red substance. The coal for the making of gunpowder is either that of willow or hazel, well charred in the usual manner, and reduced to powder. And thus the ingredients are prepared for making this commodity: but as these ingredients require to be intimately mixed, and as there would be danger of their firing if beat in a dry form, the method is to keep them continually moist, either with

water,

water, urine, or a solution of sal ammoniac; they continue thus stamping them together for twenty-four hours; after which the mass is fit for corning and drying in the sun, or otherwise, so as sedulously to prevent its firing.

The three ingredients of gunpowder are mixed in various proportions according as the powder is intended for musquets, great guns, or mortars: though these proportions seem not to be perfectly adjusted or settled by competent experience. Semeinowitz, for mortars, directs an hundred pounds of saltpetre, twenty-five of sulphur, and as many of charcoal; for great guns, an hundred pounds of saltpetre, fifteen pounds of sulphur, and eighteen pounds of charcoal; for muskets and pistols, an hundred pounds of saltpetre, eight pounds of sulphur, and ten pounds of charcoal. Miethius extols the proportion of one pound of saltpetre to three ounces of charcoal, and two or two and a quarter of sulphur; than which, he asserts, no gunpowder can possibly be stronger. He adds, that the usual practice of making the gunpowder weaker for mortars than guns, is without any foundation, and renders the expence needlessly much greater: for whereas to load a large mortar, twenty-four pounds of common powder is required, and consequently, to load it ten times, two hundred and forty pounds, he shews, by calculation, that the same effect would be had by one hundred and fifty pounds of the strong powder.

On this subject Mr. Thomson observes, that almost all those who have written upon gunpowder, particularly those of the last century, have given different receipts for its composition; and he proposes it as a query, Whether these differences have not arisen from observing that some kinds of powder were better adapted to particular purposes than others, or from experiments made on purpose to ascertain the fact? "There is one circumstance (he says) that would lead us to suppose that this was the case. That kind of powder designed for mortars and great guns was weaker than that intended for small arms: for, if there is any foundation for these conjectures, it is certain, that the weakest powder, or the heaviest in proportion to its elastic force, ought to be used to impel the heaviest bullets; and particularly in guns that are imperfectly formed, where the vent is large, and the windage very great. I am perfectly aware (adds he), that an objection may here be made, viz. that the elastic fluid generated from gunpowder must be supposed to have the same properties very nearly, whatever may be the proportion of its several ingredients; and that therefore the only difference there can be in powder is, that one kind may generate more of this fluid, and another less; and that when it is generated it acts in the same manner, and will alike escape, and with the same velocity, by any passage it can find. But to this I answer, that though the fluid may be the same, as it undoubtedly is, and though its density and elasticity may be the same in all cases at the instant of its generation; yet, in the explosion, the elastic and unelastic parts are so mixed together, that I imagine the fluid cannot expand without taking the gross matter along with it; and the velocity with which the flame issues at the vent is to be computed from the elasticity of the fluid, and the density or weight of the fluid and gross matter taken together, and not simply from the density and elasticity of the fluid."

To increase the strength of powder, Dr. Shaw thinks it proper to make the grains considerably large, and to have it well sifted from

from the small dust. We see that gunpowder reduced to dust has little explosive force; but when the grains are large, the flame of one grain has a ready passage to another, so that the whole parcel may thus take fire nearly at the same time, otherwise much force may be lost, or many of the grains go away as shot unfired.

In the 71st volume of the *Phil. Transf.* Mr. Thomson gives an account of several attempts to augment the force of gunpowder by the addition of different ingredients. The power of steam has by many been over-rated to such a degree, as to be supposed capable of answering the purposes of gunpowder; but no attempts to accomplish this have ever succeeded in any degree. Mr. Thomson attempted to combine the forces of steam and gunpowder together in the following manner. Having procured a number of air-bladders of very small fishes, he put different quantities of water into them from the size of a small pea to that of a pistol bullet, and, tying them up with some very fine thread, hung them up to dry on the outside. He then provided a number of cartridges made of fine paper, and filled them with a quantity of gunpowder equal to the usual charge of a common horseman's pistol. He then loaded the pistol with a bullet, fired it against an oaken plank about six feet from the muzzle, and observed the recoil and penetration of the bullet. He next tried the effect of one of these small bladders of water when put among the gunpowder, but always found the force of the powder very much diminished, and the larger the quantity of water the greater was the diminution; the report of the explosion was also diminished in a still greater proportion than the force of the bullet or recoil. It being supposed that the bladder had burst, and thus by wetting the gunpowder prevented it from taking fire, the experiment was repeated with highly-rectified spirit of wine, but the diminution of the force was very little inferior to what it had been with water. Etherial oil of turpentine and small quantities of quicksilver were also tried, but with no better success than before. Thinking, however, that the failure of the quicksilver might be owing to its having been too much in a body, the experiment was repeated with the metal dispersed in small particles through the powder. To accomplish this dispersion the more completely, twenty grains of Ethiop's mineral were mixed very intimately with one hundred and forty-five grains of powder; but still the force of the bullet was much less than if the powder had been used without any addition. As the explosion of *pulvis fulminans* appears vastly superior to that of gunpowder, some salt of tartar, in its purest state, was mixed in the proportion of twenty grains to one hundred and forty-five of powder; but, on firing the piece, it was still found that the force of the explosion was lessened. Sal ammoniac was next tried; which, under certain circumstances, is found to produce a great quantity of air or elastic vapour; but, on mixing twenty grains of it with one hundred and forty-five of gunpowder, the force of the explosion was still found to be diminished. As most of the metals, when dissolved in acids, particularly brass in spirit of nitre, are found to produce much elastic vapour, it was thought worth while to try whether the force of powder could be augmented by this means. Twenty grains of brass dust were therefore mixed with one hundred and forty-five grains of powder; but still the force of the explosion was not augmented. In our author's opinion, however, neither brass dust nor Ethiop's mineral diminish the force

of the explosion otherwise than by filling up the interstices between the grains, obstructing the passage of the flame, and thus impeding the progress of the inflammation. Thus it appears, that little hope remains of augmenting the force of gunpowder by any addition either of liquid or inflammable solids: the reason is obvious, viz. because all of them, the liquids especially, absorb great quantities of heat before they can be converted into vapour; and this vapour, after it is formed, requires more heat to make it expand more forcibly than air: hence, as the effects of gunpowder depend entirely upon the emission of a quantity of air, and its rarefaction by vehement heat, the power must be greatly diminished by the absorption of this heat, which ought to be spent in rarefying the air. Even solid bodies cannot be set on fire without a previous absorption of heat to convert them into vapour; but liquids have this property still more than solids, and must therefore diminish the explosive force still more. Lime added to gunpowder, however, is said to augment the power of the explosion by one third.

In his experiments on gunpowder, Mr. Thomson had the curiosity to compare the strength of aurum fulminans, when inclosed in a gun-barrel, with that of common gunpowder; but his experiment only verified what has been found by others, viz. that this powder, which in the open air makes such a violent report, has in close vessels scarcely any power, comparatively speaking, either of explosion or of projecting a bullet. Mr. Thomson, however, taking it for granted that the power of aurum fulminans would be found much greater than that of gunpowder, took care to have a barrel of uncommon strength prepared for the experiment. The weight of it was 7lb. 5 oz. the length 13.25 inches, and the width of the bore 0.55 inches. This barrel was charged with 27.44 grains of aurum fulminans and two leaden bullets, which, together with the leather put about them to make them fit the bore without windage, weighed 427 grains: it was laid upon a chaffing-dish of live coals at the distance of about ten feet from the pendulum, and the piece was directed against the centre of the pendulum. Some minutes elapsed before the powder exploded; but, when it did so, the explosion did not much exceed the report of a well-charged air-gun; and it was not until he saw the pendulum in motion, that Mr. Thomson could be persuaded that the bullets had been discharged. On examination, however, it was found that nothing had been left in the barrel, and that the powder had probably been all exploded, as a great many particles of the revived metal were thrown about. From a calculation of the motion communicated to the pendulum, it was found that the velocity of the bullets had been about four hundred and twenty-eight feet in a second; whence it appears that the power of aurum fulminans, compared with that of gunpowder, is only as four to thirteen very nearly.

There are two general methods of examining gunpowder; one with regard to its purity, the other with regard to its strength. Its purity is known by laying two or three little heaps near each other upon white paper, and firing one of them. For if this takes fire readily, and the smoke rises upright, without leaving any drops or feculent matter behind, and without burning the paper, or firing the other heaps, it is esteemed a sign that the sulphur and nitre were well purified, that the coal was good, and that the three ingredients

were thoroughly incorporated together : but, if the other heaps also take fire at the same time, it is presumed, that either common salt was mixed with the nitre, or that the coal was not well ground, or the whole mass not well beat and mixed together; and, if either the nitre or sulphur be not well purified, the paper will be black or spotted.

Several instruments have been invented to try the strength of gunpowder ; but they have generally been complained of as inaccurate. Mr. Thomson, in the 71st volume of the Philosophical Transactions, gives an account of an exact method of proving the strength of it. "As the force of powder (says he) arises from the action of an elastic fluid that is generated from it in its inflammation, the quicker the charge takes fire, the more of this fluid will be generated in any given short space of time, and the greater of course will its effect be upon the bullet. But in the common method of proving gunpowder, the weight by which the powder is confined is so great in proportion to the quantity of the charge, that there is time quite sufficient for the charge to be all inflamed, even when the powder is of the slowest composition, before the body to be put in motion can be sensibly removed from its place. The experiment therefore may shew which of the two kinds of powder is the strongest, when equal quantities of both are confined in equal spaces, and both completely inflamed ; but the degree of the inflammability, which is a property essential to the goodness of the powder, cannot by these means be ascertained. Hence it appears how powder may answer to the proof, such as is commonly required, and may nevertheless turn out very indifferent when it comes to be used in service. But, though the common powder-triers may shew powder to be better than it really is, they can never make it appear to be worse than it is ; it will therefore always be the interest of those who manufacture the commodity to adhere to the old method of proof, but the purchaser will find his account in having it examined in a method by which its goodness may be ascertained with greater precision."

In order to determine the goodness of powder by Mr. Thomson's method, it is necessary to have a barrel suspended by two iron rods in such a manner that it can easily move backward or forward by the vibration of the rods ; and the space it moves through ascertained by marking it on a piece of ribbon. The barrel being then charged with powder, and fitted with a proper bullet, is to be fired, and the recoil marked upon the ribbon. The experiment is to be repeated three or four times, or oftener if there is any difference in the recoil ; the extremes of which may be marked with black lines on the ribbon, and the word proof written upon the middle line betwixt the two. But, if the experiments are made with sufficient accuracy, there will commonly be very little difference in the length to which the ribbon is drawn out. Thus the comparative goodness of powder may easily be ascertained ; for the stronger the powder is, the greater will be the recoil, and consequently the greater length to which the ribbon will be drawn out ; and if care is taken in proportioning the charge to the weight of the bullet, to come as near as possible to the medium proportion that obtains in practice, the determination of the goodness of gunpowder from the result of this experiment cannot fail to hold good in actual service. The bullets should be made to fit the bore with very little windage ; and it would be better if they were

all cast in one mould and from the same parcel of lead; as in that case their weights and dimensions would be more accurately the same; and the experiments would of course be more conclusive. The stated charge of powder might be half an ounce, and it should always be put up in a cartridge; and, after the piece is loaded, it should be primed with other powder, first taking care to prick the cartridge by thrusting a priming-wire down the vent.

From several experiments it appears, that the effect of the charge is considerably augmented or diminished, according to the greater or less force employed in ramming it down. To prevent this inconvenience, Mr. Thomson advises the use of a cylindric ramrod of wood, fitted with a metal ring about an inch or an inch and an half in diameter; which, being placed at a proper distance from the end which goes up into the bore, will prevent the powder from being too much compressed. In making experiments of this kind, however, it is necessary to pay attention to the heat of the barrel as well as to the temperature of the atmosphere; for heat and cold, dryness and moisture, have a very sensible effect upon gunpowder to augment or diminish its force. When a very great degree of accuracy therefore happens to be requisite, it will be proper to begin by firing the piece two or three times, merely to warm it; after which three or four experiments may be made with standard powder, to determine the proof: mark a second time, for the strength of powder is different at different times, in consequence of the state of the atmosphere. After this the experiments may be made with the powder that is to be proved, taking care to preserve the same interval of time between the discharges, that the heat of the piece may be the same in each trial.

Having thus determined the comparative degrees of strength of two different kinds of powder, their comparative value may be ascertained by augmenting the quantity of the weaker powder till the velocity of the bullets in both cases becomes the same. The strong powder is therefore precisely as much more valuable than the weak, as it produces the same effect with a smaller quantity. Thus, if a quarter of an ounce of one kind of powder discharges a bullet with the same velocity that half an ounce of another kind does, it is plain that the former is twice as valuable as the latter, and ought to be sold at double the price.—By comparisons of this kind, Mr. Thomson found that the best Battel powder (so called from its being made at the village of Battel in Suffex) is stronger than government powder, in the proportion of four to three; but from a comparison of the prices, it appears that the former is no less than forty-one two thirds per cent. dearer than it ought to be; and consequently, that whoever uses it in preference to government powder, does it at a certain loss of forty-one two thirds per cent. of the money it costs him.

There has been much talk of a white powder, which, if it answered the character given it, might be a dangerous composition; for they pretend that this white powder will throw a ball as far as the black, yet without making a report: but none of the white powder we have seen, says Dr. Shaw, answers to this character; being, as we apprehend, commonly made either with touchwood or camphor, instead of coal.

We may observe, that though gunpowder is commonly made use of for military purposes only in small quantities, and confined in certain vessels; yet when large quantities are fired at once, even when unconfined in the open air, it is capable of producing terrible destruction. The accounts of damage done by the blowing up of magazines, powder-mills, &c. are too numerous and well-known to be here taken notice of. The following is a relation of what even a moderate quantity of powder will accomplish, when fired in the open air. "The King of Navarre took Monsegur. Captain Milon inclosed five hundred pounds of powder in a bag, which he found means to introduce, by a drain from the town, into the ditch between two principal gates; the end of the leader was hid in the grass. Every thing being ready to play off this machine, the king gave us leave to go and see its effects; which were surprising. For one of the gates was thrown into the middle of the town, and the other into the field fifty paces from the wall: all the vaults were destroyed, and a passage was made in the wall for three men to enter abreast, by which the town was taken."

From this and other accounts of the dreadful effects of gunpowder, when fired in a large quantity in the open air, it would seem, that great as its power is in close vessels, it is still greater when the air has access to it; for, from the quantity of powder requisite to charge great guns, it is by no means probable that double the quantity of powder confined in fire-arms of any size or capacity, and discharged all at once against the walls, would have produced such effects; especially when we consider that the power must have been equally great at an equal distance all round; so that, had there been other walls and gates behind this quantity of powder as well as before it, they would in all probability have been thrown down also. This conjecture seems to be somewhat confirmed by the great diminution of the force of *pulvis fulminans* and *aurum fulminans* when confined in close vessels. Mr. Thomson mentions likewise a very singular fact relative to gunpowder, which seems to be somewhat analogous to that just-mentioned; and which indeed seems to explain it; namely, that the heat communicated by gunpowder when slightly confined is much greater than when otherwise. "I was much surprised (says he), upon taking hold of the barrel immediately after an experiment when it was fired with three and thirty grains of powder without any bullet, to find it so very hot that I could scarcely bear it in my hand, evidently much hotter than I had ever found it before, notwithstanding the same charge of powder had been made use of in the two preceding experiments; and in both these experiments the piece was loaded with a bullet, which one would naturally imagine, by confining the flame, and prolonging the time of its action, would heat the barrel much more than when it was fired with powder alone. I was convinced that I could not be mistaken in the fact; for it had been my constant practice to take hold of the piece to wipe it out as soon as an experiment was finished, and I never before had found any inconvenience from the heat in holding it. But in order to put the matter beyond all doubt, after letting the barrel cool down to the proper temperature, I repeated the experiment twice with the same charge of powder and a bullet; and in both these trials the heat of the piece was evidently much less than what it was in the experiment above-mentioned. Being much struck

struck with this accidental discovery of the great degree of heat that pieces acquire when they are fired with powder without any bullet, and being desirous of finding out whether it is a circumstance that obtains universally, I was very attentive to the heat of the barrel after each of the succeeding experiments; and I constantly found the heat sensibly greater when the piece was fired with powder only, than when the same charge was made to impel one or more bullets."

To account for this, our author supposes, that very little of the heat acquired in firing a piece of ordnance comes from the powder; for the time that it continues in the piece, perhaps not exceeding the 200th part of a second, is so small, that were the flame four hundred times, instead of four times, as Mr. Robins supposes, hotter than red hot iron, it is by far too short to communicate a sensible degree of heat to one of our large pieces of cannon. Besides, if the heat of the flame was sufficient to communicate such a degree of heat to the gun, it must undoubtedly be capable of burning up all combustible bodies that come in its way, and of melting lead-shot when such were used; but, instead of this, we frequently see the finest paper discharged from the mouth of a gun without being inflamed, after it has sustained the action of the fire through the whole length of the bore; and the smallest lead-shot is discharged without being melted. The objection drawn from the heat of bullets taken up immediately after being discharged from fire-arms does not hold; for bullets discharged from air-guns and even cross-bows are likewise found hot, especially when they happen to strike any hard body, and are much flattened. If a musket ball be discharged into water, or against any very soft body, it will not be sensibly heated; but if it hits a plate of iron or any other body which it cannot penetrate, it will be broken in pieces by the blow, and the dispersed parts will be found in a state little short of actual fusion. Hence our author concludes, that bullets are not heated by the flame, but by percussion. Another objection is, that the vents of brass guns are frequently enlarged to such a degree by repeatedly firing them, that the piece becomes useless. But this proves only that brass is easily corroded by the flame of gunpowder; which indeed is the case with iron also. We cannot suppose that in either case any real solution takes place; on the contrary, it is very evident that it does not: for when the vents of fire-arms are lined with gold, they will remain without enlargement for any length of time, though it is well known that gold is much more easily melted than iron. As the heat communicated to bullets, therefore, is not to be ascribed to the flame but to percussion, so the heat acquired by guns is to be attributed, in our author's opinion, to the motion and friction of the internal parts of the metal among themselves by the violent action of the flame upon the inside of the bore. To generate heat, the action of the powder must be not only sufficient to strain the metal, and produce a motion in its parts, but this effect must be extremely rapid; and the effect will be much augmented if the exertion of the force and the duration of its action are momentaneous: for in that case the fibres of the metal that are violently stretched will return with their full force, and the swift vibratory motion and attrition above-mentioned will be produced. Now the
effort

effort of any given charge of powder upon the gun is very nearly the same whether it be fired with a bullet or without; but the velocity with which the generated elastic fluid makes its escape, is much greater when the powder is fired alone than when it is made to impel one or more bullets; the heat ought therefore to be much greater in the former than in the latter case, as has been found by experiment. "But, to make this matter still plainer, (says our author,) we will suppose any given quantity of powder to be confined in a space that is just capable of containing it, and that in this situation it is set on fire. Let us suppose this space to be the chamber of a piece of ordnance, and that a bullet or any other solid body is so firmly fixed in the bore, immediately upon the charge, that the whole effort of the powder shall not be able to remove it; as the powder goes on to be inflamed, and the elastic fluid to be generated, the pressure upon the inside of the chamber will be increased, till at length all the powder being burnt, the strain upon the metal will be at its greatest height, and in this situation things will remain; the cohesion or elasticity of the particles of metal counterbalancing the pressure of the fluid.—Under these circumstances very little heat would be generated; for the continued effort of the elastic fluid would approach to the nature of the pressure of a weight; and that concussion, vibration, and friction, among the particles of the metal, which in the collision of elastic bodies is the cause of the heat produced, would scarcely take effect. But, instead of being firmly fixed in its place, let the bullet now be moveable, but let it give way with great difficulty, and by slow degrees. In this case the elastic fluid will be generated as before, and will exert its whole force upon the chamber of the piece; but as the bullet gives way to the pressure, and moves on in the bore, the fluid will expand itself and grow weaker, and the particles of the metal will gradually return to their former situations; but the velocity with which the metal restores itself being but small, the vibration that remains in the metal after the elastic fluid has made its escape will be very languid, as will the heat be which is generated by it. But if, instead of giving way with so much difficulty, the bullet is made lighter, so as to afford but little resistance to the elastic fluid in making its escape, or if it is fired without any bullet at all; then, there being little or nothing to oppose the passage of the flame through the bore, it will expand itself with an amazing velocity, and its action upon the gun will cease almost in an instant; the strained metal will restore itself with a very rapid motion, and a sharp vibration will ensue, by which the piece will be much heated."

This reasoning of Mr. Thomson's, however, seems not to be very well founded. In the first place, we are by no means certain that heat is produced by the motion or vibration of the particles of a solid body among each other. On the contrary, even in the hottest bodies we cannot be made sensible of vibration existing among their particles, while certain sounds will cause the most solid substances to vibrate perceptibly, and yet without producing any heat.—From this as well as innumerable other experiments, it is probable, that heat consists in the emission of a certain subtiler fluid from the heated body, which is every moment replaced from the atmosphere, or from some other source. Hence the more air that has access to any

burning body, the hotter it will become, and the more will any other that is in its vicinity be heated. This is evident from the contrivance of Argand's lamp, which is neither more nor less than the admission of a larger quantity of air to the same quantity of flame. The case is the same with the firing of gunpowder; when a bullet is put into the piece, the access of the air is much more effectually prevented than when only a simple wadding is made use of. In consequence of this, no sooner is the powder fired without a bullet, than the external air rushes down the bore, mingles with the flame, and vehemently augments the heat, as well as the absolute force of the explosion. It is true, that without the external air, the nitre in the gunpowder itself produces as much air as to inflame it very violently; but this does not prove that it could not be inflamed still more by the admission of more air. Besides, when the external air is thus admitted, the flame itself is agitated by its admission, and driven against the sides of the piece with a force superior to what it has by the mere expansive pressure; whence the heat must also be considerably augmented, in the same manner that the heat of any other body will be by having flame blown against it, instead of being blown away from it, or suffered to burn quietly by its side. Thus, without any recourse to an unknown and conjectural vibration among the particles of a solid metal, we may account for the augmented heat of a piece charged only with powder, and likewise in some measure for the prodigious force of gunpowder, aurum fulminans, and pulvis fulminans, when fired in the open air, compared with what they have when exploded in close vessels.—The force of gunpowder is manifestly augmented in close vessels, as has been already said, by being rammed down or compressed together: but this arises from another cause, namely, that a greater quantity of flame is compressed into the same space than when the powder is not rammed; and this compression of the flame is in proportion to the compression of the powder in the chamber of the piece. But in this case the flame is probably less powerful than in the former, though the quantity inclosed in a small space may probably make up for the quality. Mr. Thomson's experiments on the increased force of gunpowder by compression are as follows:—Having put a charge of 218 grains of powder, inclosed in a cartridge of very fine paper, gently into the bore of the piece, the velocity of the bullets, at a mean of four experiments, was at the rate of 1225 feet in a second; but in a medium of three experiments, when the same quantity of powder was rammed down by five or six strokes of the ram-rod, the velocity was 1329 feet in a second. “Now (says he) the total force or pressure exerted by the charge upon the bullet, is as the square of its velocity; and 1329² is to 1225² as 1.776 is to 1; or nearly as 6 is to 5: and in that proportion was the force of the given charge of powder increased by being rammed.—When, instead of ramming the powder, or pressing it gently together in the bore, it is put into a space larger than it is capable of filling, the force of the charge is thereby very sensibly lessened, as Mr. Robins and others have found by repeated trials. In my 30th experiment, the charge, consisting of no more than 165 grains of powder, was made to occupy 3.2 inches of the bore, instead of 1.45 inches, which space it just filled. When it was gently pushed into its place without being rammed, the consequence was, that the velocity

velocity of the bullet, instead of being 1100 feet or upwards in a second, was only at the rate of 914 feet, and the recoil was lessened in proportion. Hence we may draw this practical inference, that the powder with which a piece of ordnance or a fire-arm is charged, ought always to be pressed together in the bore; and, if it is rammed to a certain degree, the velocity of the bullet will be still farther increased. It is well known that the recoil of a musket is greater when its charge is rammed than when it is not; and there cannot be a stronger proof that ramming increases the force of powder."

The method of recovering damaged gunpowder is, to put part of the powder on a sail-cloth, to which add an equal weight of what is really good; and with a shovel mingle it well together, dry it in the sun, and barrel it up, keeping it in a dry and proper place. Others again, if it be very bad, restore it by moistening it with vinegar, water, urine, or brandy: then they beat it fine, scarce it, and to every pound of powder add an ounce, an ounce and a half, or two ounces, according as it is decayed, of melted salt-petre. Afterwards, these ingredients are to be moistened and mixed well, so that nothing can be discerned in the composition, which may be known by cutting the mass; and then they granulate it as aforesaid. In case the powder be in a manner quite spoiled, the only way is to extract the salt-petre with water according to the usual manner, by boiling, filtrating, evaporating, and crystallizing; and then with fresh sulphur and charcoal to make it up anew again.

In regard to the medical virtues of gunpowder, Boerhaave informs us, that the flame of it affords a very healthy fume in the height of the plague, because the explosive acid vapour of nitre and sulphur corrects the air; and that the same vapour, if received in a small close pent-up place, kills insects.

It is enacted by 5 and 11 of Geo. I. and 5 Geo. II. c. 20. that gunpowder be carried to any place in a covered carriage; the barrels being close-jointed; or in cases and bags of leather, &c. And persons keeping more than two hundred pounds weight of gunpowder at one time; within the cities of London and Westminster, or the suburbs, &c. are liable to forfeitures if it be not removed; and justices of peace may issue warrants to search for, seize, and remove, the same.

OF NECROMANCY.

THIS superstitions and impious imposture appears to have had its origin at a very early period in Egypt, and to have been thence propagated in every nation with the manners of which history has made us acquainted. The conquests of Sesostris might introduce it into India; the Israelites would naturally borrow it from the people among whom they sojourned four hundred years; and it would easily find its way into Phœnicia, from the vicinity of that country to the land of its nativity. From the Egyptians and Phœnicians it was adopted, with the other rites of paganism, by the Greeks; and it was imported into Rome with Grecian literature and Grecian manners. It was not however confined to the pagan nations of antiquity; it

it spread itself through all the modern nations of Europe, and took such deep root as to be long retained even after those nations were converted to the Christian faith.

Of its early antiquity we have complete evidence in the writings of Moses, where it is severely condemned as an abomination to the Lord; and, though it appears to have been then spread in Phœnicia, we might yet conclude its birth-place to have been Egypt, because, at their exodus, the Israelites were corrupted only by Egyptian superstitions, and because necromancy seems to be one of those whoredoms which the prophet Ezekiel represents his countrymen as having brought with them from Egypt, and continued to practise till they were carried captives into Babylon.

If from sacred we proceed to consult profane authors, we shall find them not only affirming Egypt to have been the birth-place of necromancy, but in some degree accounting for the origin of so impious a delusion. From Diodorus the Sicilian we learn, that the Grecian fable of Charon the ferry-man of hell, of Styx, Coccytus, the Elysian Fields, Tartarus, the judgment of Minos and Rhadamanthus, &c. with the whole scenery of the infernal regions, were imported from Egypt into Greece. The ancient Egyptians, and indeed all the people of the east, made use of caves for burying places, which were well suited to the solemn sadness of the surviving friends, and proper receptacles for those who were never more to behold the light. In Egypt, many of those subterraneous cavities, being dug out of the natural rock, still remain, and command the admiration of travellers; and near to the pyramids in particular there are some apartments of a wonderful fabric, which though they extend in length four thousand four hundred feet, and are about thirty feet in depth, appear to have been, if not entirely dug, at least reduced to form, by the chissel or pick-axe of the artist.

From the practice of burying in such caverns sprung the opinion that the infernal mansions were situated somewhere near the centre of the earth, which by the Egyptians was believed to be not very distant from its surface. In these dreary mansions, it was very easy for such adepts as the priests of Egypt to fabricate Erebus, Tartarus, the Elysian Fields, and all those scenes which were displayed before the initiated in the mysteries, and by them described to the million of the people. As it was in those dark abodes that necromancy was practised, it would be no difficult matter for such magicians as withstood Moses to impose so far upon the credulous vulgar, as to make them believe, that in consequence of their avocations they actually saw the ghosts of their friends ascend out of the earth. It appears from the book of Exodus, that the Israelitish women were, even in the wilderness, well acquainted with the use of the mirror, which was therefore undoubtedly known to the Egyptians. But a mirror of a particular form and properly illuminated at the instant required, might easily be made to reflect, in a cavern from which all other light was carefully excluded, the image of the deceased, who was called upon by the necromancer; and we can readily conceive, that, with respect to the question to be proposed, a person might be concealed, prepared to give such ambiguous answers as would satisfy the inquirer, and at the same time save the credit of the oracle. The terrified imaginations of the spectators would aid the delusion, and make a

very slight resemblance pass for the ghost or εἰδωλον of their departed friend; or the necromancer might assign plausible reasons why a spectre, after having dwelt for some time in the infernal regions, should lose something of its resemblance to the body which it animated. Such juggling tricks, though performed by artists less accomplished than Jann. and Jambres, have gained credit among people much more enlightened than the Egyptians can possibly have been when the science of necromancy was invented by their priests.

That the Israelites, notwithstanding the prohibition of their legislator, continued to practise the rites of necromancy, is apparent from Saul's transaction with the witch of Endor. From the same transaction, it is likewise apparent that the witches of Israel, and therefore in all probability the necromancers of Egypt, pretended to evocate the ghosts of the dead by a dæmon or familiar spirit, which they had at their command to employ upon every emergency. This dæmon was called OB; and therefore Saul desires his servants to find him a woman who was mistress of an OB. It is probable that those wretched impostors had in their pay some persons who occasionally acted the part of the dæmon, and, when the execution of the plot required their agency, emitted, by means of a cavity dug for that purpose, a low hollow voice from below the ground. Hence we find Isaiah, in his denunciations against Ariel, saying, "Thou shalt be brought down, and shalt speak out of the ground; and thy speech shall be low out of the dust, and thy voice shall be as one that hath a familiar spirit (an OB) out of the ground, and thy speech shall whisper out of the dust."

But though the Egyptian priests were undoubtedly the inventors of the whole mystery of necromancy, and though it was from them imported into Greece by the Selli or priests of Dodona, it does not appear that the Grecian necromancers pretended to be masters of OBs or familiar spirits. Mopsus, Orpheus, Linus, Eumolpus, &c. who either travelled into Egypt in quest of knowledge, or were actually natives of that country, instructed the early Greeks in this occult science: but, whatever might be the practice of these apostles themselves, their disciples professed to do all the feats of magic by performing certain rites, by offering certain sacrifices, by muttering a certain form of words, by charms, spells, and exorcisms. By these they pretended to evocate the dead as certainly as the Egyptians and Jews did by their familiar spirits. By a small display of critical learning this might be easily proved from the popular story of Orpheus and Eurydice, which certainly was founded on one of these necromantic deceptions exhibited in a cave near Dodona, where the priests had a hades or infernal mansion, in humble imitation of those with which the first of them were well acquainted in Egypt. It is indeed evident, without the aid of criticism: no man of any letters is ignorant, that whatever superstitions of this kind prevailed among the Romans were borrowed from the Greeks. But we all know that Virgil makes one of his shepherds, by means of certain herbs, poisons, and senseless charms, raise up ghosts from the bottoms of their graves; and Lucan has fabricated a story of this kind, which may be considered as an exact parallel to the witch of Endor. Just before the battle of Pharsalia he makes young Pompey travel by night to a Thessalian forcerefs, and anxiously inquire of her the issue of
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the war. This female necromancer, by a tedious process of charms and incantations, conjures up the ghost of a soldier who had been lately slain. The phantom, after a long preamble, denounces a prediction much of the same kind with that which the King of Israel received from Samuel at Endor; and though nothing but the spirit of God could have foreseen the inevitable destruction of Saul, his sons, and his army, it was very easy for any man of tolerable sagacity to foresee the defeat of Pompey's raw and undisciplined troops by the hardy veterans of the victorious Cæsar.

It would be endless to enumerate all the fallacious evocations of ghosts, and the ambiguous responses returned by those pretended spirits, of which we have accounts from the poets and historians of the celebrated nations of antiquity. We shall therefore proceed to mention a few which occur in the fabulous history of more modern nations, and then leave the subject to the meditation of our readers. In Mallet's Northern Antiquities, we have the following account of a necromantic exploit, between which, and the descent of the ancient heroes into hell, it is impossible not to remark a striking similitude.

"Odin, the sovereign of man, arises. He saddles his horse Sleipner; he mounts, and is conveyed to the subterraneous abode of Hela. The dog which guards the gates of death meets him. His breast and his jaws are stained with blood. He opens his voracious mouth to bite, and barks a long time at the father of magic. Odin pursues his way; and the infernal cavern resounds and trembles under his horse's hoofs. At length he reaches the deep abode of death, and stops near the eastern gate, where stands the tomb of the prophets. He sings with a voice adapted to call up the dead; he looks towards the world; he engraves Runic characters on her tomb; he utters mysterious words; and he demands an answer, until the prophets is constrained to arise and thus utter the words of the dead:—"Who is this unknown that dares to disturb my repose, and drag me from the grave, in which I have been dead so long, all covered with snow, and moistened with the rains?" &c.

The Gallic druids pretended to be masters of the same secret. This is evident from the name of a species of divination, not uncommon among the Scotch Highlanders so lately as in the beginning of the present century. By a gentleman excellently versed in the antiquities of that people, we have been informed, that not many years ago some of the Highlanders relied implicitly upon certain oracular responses, called in their language taghairm. This word seems to be compounded of *ta*, which in some parts of the Highlands is still used to denote a spirit or ghost, and *ghairm*, which signifies calling upon or invoking. Taghairm, therefore, in its original import, is necromancy in the most proper sense of that word.

There were different kinds of taghairm, of which one was very lately practised in Sky. The diviner covered himself with a cow's hide, and repaired at night to some deep-sounding cave, whither the person who consulted him followed soon after without any attendants. At the mouth of the cave he proposed aloud the questions of which he wanted solutions; and the man within pronounced the responses in a tone of voice similar to that with which the *ors*, or pretended dæmons of antiquity, gave from beneath the ground their oracular answers. That in the latter days of taghairm, the Gallic diviners

pretended to evocate ghosts, and from them to extort solutions of difficulties proposed, we have no positive evidence; but that such was the original pretence, there can be little doubt, when we reflect either upon the place where this species of divination was practised, or upon the import of the word by which it was denominated.

As we have been led to mention taghairm, we shall beg leave to make a few observations on another species of it, called taghairm an uisge, or "taghairm by water." This too was last practised in the Isle of Sky, by a man of the name of M'Cuidhean, whose ancestors had long been famous for the art. He lived near a beautiful cascade on a small river; and, when consulted on any matter of consequence, he covered his whole body with a cow's hide, that necessary implement of Highland divination, and placed himself between the water of the cascade and the rock over which it flowed. Then another man with a heavy pole gave repeated strokes to the water, and the diviner behind it crying out now and then in Gaelic, "Is this a stock of arn?" This operation was continued till M'Cuidhean was perceived to be frantic or furious, when he was considered as in a condition to answer the most important questions. He was frequently consulted about futurity; and though he could not, in the proper sense of the word, be called a necromancer, his responses were listened to as proceeding from something more than human. A degree of frenzy, either real or affected, seems to have accompanied the predictions of certain kinds of diviners in all ages; and we cannot help remarking the similarity between the madness of M'Cuidhean and that of the Sybil in the sixth book of the *Æneid*; though we cannot suppose the one to have been borrowed from the other.

*At, Phabi nondum patiens, immanis in antra
Bacchatur vates, magnum si pectore possit
Excussisse Deum; tanto magis ille fatigat
Os rabidum, fera corda domans, fingitque premedo.*

Struggling in vain, impatient of her load,
And lab'ring underneath the pond'rous god;
The more she strove to shake him from her breast,
With more and far superior force he press'd.

DRYDEN.

That all these pretences, whether ancient or modern, to the power of divination by means of familiar spirits, or by the art of necromancy, were groundless as well as impious, it would be affronting the understandings of our readers to offer any proof. We have said enough to those who know that dæmons, if they have any existence, and the departed spirits of good and bad men, are all under the controul of Him who governs the intellectual as well as material world by fixed and equal laws.—These details of superstition, however, will not be useless, if, by shewing how poor and wretched a creature man becomes when left to his own inventions, they shall make any one grateful for the benefits of good government, and the blessings of revealed religion.

ART OF DYING WOOL, SILK, COTTON, &c.

THE art of dying, or of imparting to different materials, employed for the fabrication of garments and furniture, those beautiful colours which are afforded by many articles of the vegetable, animal, and mineral, kingdoms, appears to have been of high antiquity. As most of these materials are, of themselves, either of dark and disagreeable colours, or else devoid of all colour, it is probable, that, even in the very earliest ages, the love of ornament, which is natural to mankind, would induce them to stain their vestments with various colouring ingredients, especially with vegetable juices. But the art of imparting permanent dyes to cloth, and affixing to its fibres such colouring materials as could not easily be washed out by water, or obliterated, or greatly changed, by the action of air, or of certain saline substances, to which they are liable to be exposed, and which are necessary to render them clean, when soiled; this was an art which required the knowledge of principles not within the reach of untutored men, and only to be obtained by gradual investigation, and in long process of time.

It has been proved by the ingenious Mr. Delaval, F. R. S. that the Egyptians were possessed of the art of dying, and even of that of printing on cloths. In a passage which he has quoted from Pliny, that author relates, that the Egyptians having besmeared, or drawn on, white cloth with various substances, which were in themselves colourless, but capable of absorbing colouring matter, threw it into a caldron of hot liquor, tinged with dying materials, and that, though the parts, thus drawn upon, were not distinguishable before the cloth was immersed in the colouring liquor, and though this liquor contained only one colour, it was surprising to see the cloth taken out stained with several different colours, according as the different parts of it had been impregnated with the various substances capable of receiving and altering the nature of the pigment.

The Phœnicians held a decided pre-eminence in the tinctorian art, for many ages; their purple and scarlet cloths were sought after by every civilized nation, and the city of Tyre, enriched by its commerce, increased to an amazing extent. But her career was stopped by the vanity and folly of the eastern emperors, under whose dominion this opulent city had unfortunately fallen. Desirous of monopolizing the wearing of the beautiful cloths of Tyre, these misjudging tyrants issued most severe edicts, prohibiting any one from appearing in the Tyrian blue, purple, or scarlet, except themselves, and their great officers of state. The enacting and enforcing of sumptuary laws requires great judgment and delicacy, and much caution should be used, lest, in curbing excessive luxury, the arts, which are supported by its moderate indulgence, should be destroyed. Such, however, was the fate of the Tyrian dyes. Under the impolitic restraint imposed on the consumption of the Phœnician cloths, the manufacturers and dyers were no longer able to carry on their trade; it grew languid, sickened, and expired, and, with the trade, the art likewise perished.

This example, of the interference of government so materially injuring, and even annihilating, an useful art, and the commerce depending

depending on it, though carried to an excess never likely to be imitated in these days, should make ministers cautious that they do not form laws which may discourage or fetter our manufactures; for freedom is the very soul of trade, and in proportion as the one is invaded, the other will certainly decline.

In this nation, the art of dying had made no considerable progress till about the beginning of the last century; before that period our cloths were sent to Holland to be dressed and dyed. Probably, however, this was practised only in the case of particular colours; for it appears that the dyers of London received their charter of incorporation from Henry VI. There is a small tract, printed so long ago as the year 1596, entitled, "A profitable Book, declaring Divers approved Remedies to take out Spots and Staines, in Silkes, Velvets, Linen, and Woollen Clothes; with divers Colours how to dye Velvets and Silkes, Linen and Woollen, Fustian and Threade. Also to dresse Leather, and to colour Felles, &c. &c. very necessarie for all men, especially for those who hath or shall have any Doings therein; with a perfect Table thereto, to find all Things ready, not the like reveled in England heretofore. Taken out of Dutche and Englished by L. M. Imprinted at London, by Thomas Parfoot, dwelling in the New Rents." This little book, published at so early a period, contains many good processes, and it is to be lamented that, during so long a lapse of time, the English nation has not produced any work on this subject much superior to it. The mode of computing the length of time, employed in many of the processes contained in this publication, is curious. The immersion of the subject in the dying liquor is, in general, ordered to be continued, not for so many minutes, but for five, six, or seven, pater-nosters long.

The dying of woollen and silken goods has long since attained a considerable degree of excellence, while the manufactures of cotton, owing to the small attraction of that substance for colouring matter, have been very deficient in this point. Till within these few years, the colours employed in the dying of fustians and cotton velvets were few; and, even at this day, many of them are fugitive. But it must be allowed that improvements have been made within these few years; improvements principally owing to the ingenuity and public spirit of Mr. Wilson, who, by the application of chemical principles, and by a diligent investigation of the nature of colouring substances, laid the foundation on which the present fabric is erected.

Much room is, however, still left for the improvement of the art; it is only by our practical dyers acquiring chemical knowledge, that it can ever be effected, to any great extent.

Wool has naturally so strong an attraction for colouring matter as to need but little preparation, previous to the more immediate processes of dying; it is only necessary to scour from it a greasy or fatty substance, called the yolk, which is contained in the fleece. For this purpose an alkaline liquor is necessary; but, as alkalies injure the texture of the wool, it is requisite that a very dilute solution be employed; for, were the quantity of salt greater than is sufficient for converting the yolk into a soap, it would attack the substance of the wool. Putrid urine, therefore, is generally used, as being cheap, and containing a volatile alkaline salt, which, uniting with the greasy matter, renders it soluble in water.

Silk, when taken from the cone, is covered with a kind of varnish, which makes it feel rough and hard to the touch, tarnishes its whiteness, and is generally said to be of such a nature as to be neither soluble in water nor in spirit of wine. It has been thought that the only solvent for this substance is a solution of alkaline salt; and this is commonly applied in the form of soap. The soap should always be of the best quality; for, inferior soaps, especially those made with animal fat, are not only less powerful in their action, but are apt to stain or discolour the silk. The silk in this operation loses about one fourth of its weight. The matter separated from it is highly putrescent, for, if a hank of silk which has been thus treated be not washed after the operation, it will in a few days grow hot, stink, and be covered with small white worms, which feed on the soapy and glutinous matter remaining in the silk. The liquor in which it has been boiled also soon putrefies, and becomes useless. Could this animal matter, says M. Macquer, be precipitated from the soap before putrefaction takes place, the soap might be recovered, and thus a considerable saving made to the dyer.

The use of the best soaps has been recommended; but even these are suspected of being detrimental to the whiteness of the silk; and Chinese silk, which exceeds the European in lustre, is said to be prepared without soap. The French Academy therefore, some years ago, offered a prize for the discovery of a method of cleaning silk without soap; the prize was obtained by M. Rigaut, whose mode was to use a slender alkaline solution instead of soap.

But Mons. l'Abbé Cullomb has lately gone farther, and has actually dissolved in water the varnish of silk, which has always been supposed to be of that oleo-resinous kind as not to be acted on even by spirit of wine. He exposed a quantity of raw silk to the action of boiling water for nine hours, and found it freed from the varnish, with the loss of one fourth of its weight.

Though the silk by these means acquires a considerable degree of whiteness, if intended to receive some of the most brilliant colours a farther operation is requisite. This consists in exposing the silk to the fumes of burning sulphur, so confined in a stove that none shall escape, but the whole be applied to the material intended to be whitened.

But, though thus rendered more fit for exhibiting the brilliant colours, the attraction of the silk for colouring matter is rather diminished than increased; the raw or unscoured silk being more easily and permanently dyed, than that which has passed the above-described process.

Cotton and linen are prepared for the purposes of dying by being boiled in solutions of alkaline salts, and afterwards exposed to the air, and the sun's rays, in the bleach-field. Linen, containing much oily and resinous matter, requires a strong solution of alkaline salts, and that they be in a caustic state; but cotton not having any resinous matter, and not much superabundant oil, the milder alkalies are more beneficially employed for the bleaching of it. The new mode of bleaching by means of the dephlogisticated marine acid, which has been very lately introduced into our manufactures, promises to be of great utility to them; not only by shortening the time required for the process, which has been generally extended from one to two months, and may now be reduced to a few hours, but also by sending

ing up the goods in a state much better adapted to the subsequent processes.

This bleaching, or steeping in the alkaline leys, leaves in the cotton, however well washed, some earthy matter, which, being unequally distributed, would, when the cotton is to be dyed, render the application of the colour unequal. This, therefore, is to be removed by steeping in a dilute vitriolic acid, which is capable of dissolving and carrying off the earth. But this acid is also to be carefully removed by washing the cloth in water; otherwise, as it becomes dry, the acid, being gradually concentrated by the evaporation of the water, will attack and corrode the cotton.

The intention of these previous preparations seems to be two-fold: the first is, to free the material to be dyed from any extraneous matter, which might, by its want of attraction for water, prevent the absorption of the colouring liquor; for, we find that unbleached stuffs do not imbibe water with near so much avidity as those that have been bleached. The second is, that the yarn or cloth may be rendered whiter, and, by reflecting the rays of light more copiously, enable the colouring matter to exhibit more brilliant tints; to these a third intention has been added, viz. to enlarge or dilate the pores of the substance.

But, for some particular purposes, cotton requires a different and more complex preparation. In the process for dyeing the Turkey or Adrianople red, it is boiled, and repeatedly steeped in mixtures of mineral alkali, oil, and animal excrement.

Having thus considered the natures of the different subjects of dyeing, and the various preparations necessary to render them fit for the reception of colouring matters in general, let us next proceed to some description of the colouring substances which are employed in dyeing.

Though the primitive colours into which a ray of light may be divided are seven, yet the original colours produced by dyers are no more than five; viz. blue, red, yellow, brown, and black. From these, perhaps, the two last may be excluded as compounds; all the other shades, of various denominations, are formed by different combinations of these original colours.

The substances which do themselves contain colouring matter, and are used in dyeing, are chiefly of the vegetable, some of the animal, and in a few instances of the mineral, kingdom. The last consist of metallic calces, and chiefly those of iron and copper.

Of the two former, most of their component parts, in which the colouring matter resides, such as their mucilage, their gum, and the salts which they contain, are soluble in water; as, by means of these salts, are also their oily parts: to these the French writers have given the general name of extractive soapy matter. Other constituent parts of vegetables are not soluble in water, viz. some of their oily, their resinous, and their earthy, parts.

Yet we should be deceived, as M. Macquer justly observes, if we were to expect to make a perfect separation, by means of water, of the extractive soapy matter from the other parts. For, a portion of that matter is defended from the action of the water, by the resinous and oily substances; while, on the other hand, these are partially dissolved, being rendered capable of uniting to the water, by means of the mucilaginous parts.

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The colouring animal and vegetable drugs of the *materia tinctoria* have been formed by chemistry into three divisions.

First. Those substances which, together with extractive, contain some resinous, and also some portion of earthy, matter in their composition; and the colouring principle having a strong attraction to the earth, and this to the substance to be dyed, a separation from the water is easily effected, and the colour is capable of being applied, and of adhering in a durable manner, without the intervention of any medium. Of this tribe are galls, walnut rinds, the root of the tree shumach, and alder-bark; these are called root colours, as being the foundation of others.

Secondly. Other articles of the *materia tinctoria* consist of materials whose parts are either wholly extractive, or, though containing some resinous matter, are capable of being dissolved in water alone; and, being deficient in the earthy principle contained in the articles of the former division, require that an earth be previously introduced into the pores or interstices of the substance intended to be dyed, to form a basis to which the colour may adhere. Without this medium, the attraction of that substance to the colouring matter would be so weak as either not to be able to separate it from the water, or, if separated, to retain and prevent it being re-dissolved by the water, when aided by mechanical means, or by the addition of certain substances which increase its solvent powers, even in a small degree. Many of these colouring bodies, as well as those of the first division, also contain a principle, known by the appellation of the astringent principle, which greatly contributes to their fixity, and has much effect in separating the earthy parts of the salt employed to afford the above-mentioned basis. Under this description are comprehended cochineal, madder, weld, quercitron bark, and several other drugs. But other articles of this division seem to be either deficient in this principle, or else to possess it of so volatile a nature that it readily escapes, and carries along with it the colouring matter, to which it has a close attachment.

Thirdly. Another class consists of principles so prevalently resinous, that we are obliged to promote their solution in water by fermentation, or by the addition of some substance which may act on the resinous particles. For this purpose alkaline salts, or quicklime, are employed; and by their means we extract the colouring matter of some bodies, such as indigo, archil, safflower, and arnatto. These also attach themselves to the cloth, without the intervention of an earthy medium.

But the degree of fixity is various, in the different articles of the *materia tinctoria* belonging to all these divisions. Some of them belong to the less or false dye, as it is called, and are liable to be injured, and even destroyed, by the action of the sun's rays, air, water, and alkaline or acid liquors. The ingredients of the good dye, on the contrary, in a great measure withstand the influence of these agents. The former are more easily managed, are cheaper, and more brilliant; but the latter make amends for their other defects, by their solidity and permanency.

The colouring matter itself is formed, perhaps, in a great measure, of the inflammable, in some cases united to the astringent, principle. The identity of light and phlogiston, or at least that the one is a modification of the other, appears to be pretty clearly proved.

proved. Plants totally excluded from the sun's light acquire no colour; and flowers are observed, *ceteris paribus*, to possess the most beautiful tints in those climates where they enjoy the influence of that luminary the most liberally. This matter, therefore, must of itself be very fugitive, and as phlogistic bodies act on, and dissolve, each other very powerfully, we are hence enabled to account for the destructive effects of solar light on colour, when applied to the dead fibre, from its dissolving the phlogiston, in the same manner, according to Mr. Delaval, as spirit of wine dissolves camphor.

The acids also act on, and destroy, colouring matter, in proportion to their attraction for phlogiston. Thus, nitrous acid is highly and instantaneously destructive to many colours; but is exceeded in power by the dephlogisticated marine acid. This very active substance is the strongest test of all others for the goodness of dyes: for those that can withstand its action will endure every other hardship without injury.

Again, some chemists have considered iron as the colouring matter of vegetables, as it certainly is, in many instances, of minerals. But this theory does not necessarily exclude phlogiston: for, it is supposed that the various colours which plants exhibit may depend on the various states of phlogistication in which the iron exists. Thus iron when dissolved in vitriolic acid is green; apply such a degree of heat as may drive off a part of the remaining inflammable principle and the acid, it becomes yellow; and, on carrying the process still farther, it descends to red, and purple. It must be allowed that iron enters, as a component part, into most plants, and that its calces are capable of exhibiting great variety of colours; but still it is to phlogiston, or light, that we are to look up as the real cause of colour; this being the active, while the martial calces can, at most, be regarded as the passive, principle.

Since the formation of the antiphlogistian theory indeed, by which the existence of phlogiston is denied, the various colours of plants have been accounted for from the different proportions of dephlogisticated air they may retain. Plants, when exposed to the action of the sun's rays, have their water decomposed, and part with this pure air; yielding it in proportion to the quantity of light they receive, which, joining with it, gives it elasticity: but plants kept in the dark throw out none of this air, and are white. Those of the same kind, exposed to a weak light, will have some of the air separated, and have a faint degree of colour; and those which undergo the action of a strong light, will exhibit vivid tints. But, though we allow of the dephlogisticated air as producing whiteness, yet we may also acknowledge the effect of phlogiston, in producing colour; and, in fact, the antiphlogistians are obliged to admit of inflammable gas as a substitute for it; and to acknowledge, that this gas, which they suppose to be the other constituent part of water, is the principle of colour.

The colourless ingredients used in dying consist of alkaline, acid, nitrous, earthy, and metallic, salts; which contribute either to extract the colouring matter from other substances which contain it, or, by attenuating or incrassating its particles, to cause the colour to ascend or descend, according to the prismatic range. Thus, acids raise the blue colour of vegetable juices to indigo, violet, red, and yellow;

yellow; while alkalies reduce the tints, thus raised, to violet, indigo, blue, and, on a farther addition, to green.

We now shall proceed to consider the nature of the several bases; endeavour to deduce a theory of dying; and particularly to account for the action of the substances employed in the preparation for the Turkey red, and in the other parts of that process.

The whole business of dying is so truly a chemical process, or rather a combination of several chemical processes, that the invention, or at least the principal improvements of the fundamental parts, must have proceeded from men skilled in chemistry. We have seen that the Egyptians were even acquainted with the more complicated kind of dying, or callico printing; and this knowledge was not confined to them, but was possessed by other eastern nations. From the East also proceeded, to us, chemistry itself; and it is highly probable that the art was of great antiquity in that part of the globe, and had arrived at a degree of perfection of which we have at present no suitable ideas. To have invented the process of printing, in the manner described by Pliny, the inhabitants of India must probably have known how to prepare alum; they must have been acquainted with the manner of dissolving lead in the vegetable acid; they must at least have been acquainted with the component parts of these salts; and they must have had a knowledge of double elective attractions.

In our division of the various colouring substances, of the animal and vegetable kinds, there are some, viz. those of the third division, which, not having of themselves a sufficient attraction for the cloth, require to have an earthy substance applied, as an intermedium. The requisites in this earth are, that it should have a strong attraction for the material to be dyed, and also for the colouring principle; and, in many cases, that it should possess perfect whiteness, for the purpose of reflecting the rays of light, so as to enable the tinging matter to exhibit its peculiar colour with the greater brilliancy.

The substances principally used to afford the white basis for colouring matter are, alum, and solutions of tin in different acids, but generally in marine acid, or in a mixture of marine and nitrous acid, commonly known by the name of *aqua regia*.

Alum, being a cheap substance, is most commonly used. It consists of vitriolic acid, pure clay, or argillaceous earth, and water. This earth has a strong attraction for colouring matter, particularly for such as forms the red and yellow colours; inasmuch that, if a solution of alum be poured into water deeply tinged with madder or weld, the earth will quit its acid to unite with the colouring particles of these substances, and form with them a precipitate or laque; from which it cannot be separated, either by the action of water or spirit of wine, and is not totally destroyed even by that of fire.

Marine salt of tin, and that formed by *aqua regia*, have for their basis the white earth of that metal, which has also a strong attraction for colouring matter, and is, in some cases, preferred to that of alum. When united to the colouring matter of cochineal, it forms a beautiful pigment, well known by the name of carmine. If the addition of these saline substances to the coloured liquors be sufficiently long continued, and under proper circumstances, the whole of the colouring matter will be precipitated, and the water be left colourless.

Tin is not the only metal which affords bases for colouring substances; lead, bismuth, and zinc, also afford earths, or calces, which attract colouring matter; but the two first have defects which render them less eligible. The calx of zinc may perhaps be usefully employed; but should first be thoroughly purified from the iron which it generally contains.

These all form bases for the more brilliant reds and yellows: for the last, the calx of copper is also employed, having a strong attraction for the colouring matter of weld. Salts containing iron furnish a basis which, with the astringent matter of vegetables, produces a black dye.

When alum is used to supply a basis for the dying of wool, it is the practice to join with it either crude tartar or its purified crystals, in the proportion of five ounces of alum to one of tartar. This last substance we know consists of an alkaline vegetable salt, super-saturated with a peculiar acid, which bears its name. The super-abundant vitriolic acid of the alum will decompose a part of the tartar, by attaching itself to the alkali, and thus the quantity of free tartareous acid is increased, which has no properties injurious to the cloth.

In the aluming of silk no tartar is employed; for the silk, in the previous preparation, being impregnated with alkaline or soapy matter, the superabundant acid will be neutralized by it. In this process, when the tubs have been long used, a very considerable incrustation is formed on their sides; which the dyers, finding no injury from it, suffer to accumulate. Some of the soap used for the scouring adheres to the silk, notwithstanding the washing it undergoes; and, the alkali of the soap uniting with the acid of the alum, some of its earth is precipitated, joins with the detached oil, and forms the incrusting substance; the undecomposed alum, and the vitriolated tartar, perhaps also, in part, entering into the combination.

Cotton requires a still different treatment: as the vitriolic acid is injurious to cotton, and it is necessary that the aluminous solutions should be well dried on it before it be washed, the acid, being concentrated by the evaporation of the water, would corrode the cotton. It is therefore proper to saturate the superabundant acid, previous to the aluming of the cotton; and for this purpose one-sixth or one-eighth of pearl-ashes is to be added.

The solutions of tin, and of the other white metals, should be as perfectly saturated as possible; otherwise, not only the superabundant acid will injure the cloth, but the calx will not so readily precipitate, to form the white basis. In the dying of wool the solution of tin is mixed with the decoction of cochineal, and falls, in the form of carmine, on the cloth; but silk has in vain been attempted to be dyed scarlet in this mode. M. Macquer has however accomplished this desideratum, by first fully impregnating the silk with the solution, before he proceeded to the dying. By this means M. Macquer declares that he has produced scarlet, though not equal to that dyed on wool, yet sufficiently beautiful, and superior to the scarlet formed by a mixture of safflower and arnatto. And, he adds, that an eminent manufacturer at Lyons had succeeded in dying great variety of colours on silk, by applying the tin basis after the same manner.

If a scarlet could be dyed without the use of nitrous acid, the tin basis might be employed for this purpose on cotton; but, that acid being requisite for the production of this beautiful colour, and being highly corrosive to cotton, this basis is prevented from being applied to that substance.

The cupreous basis may be obtained from blue vitriol, and from verdegris, or acetated copper. It is seldom used by itself, but generally in conjunction with alum.

The martial basis, where wool and silk are concerned, is obtained from green vitriol or copperas; but this basis is best procured, for cotton, from a solution of iron in acetous acid, or even, as it should seem, in the astringent principle: for, a solution of iron is used by the dyers of cotton, with great success, which is formed by stratifying old iron with alder-bark, and digesting them in water.

It may also be worthy of remark, that cotton, having but a weak attraction for colouring matter, requires that it should be presented under every advantage; and the Dijon academicians having proved that the mineral acids are destructive of the astringent principle, in which the colouring matter of those substances requiring a basis seems to reside, this property, added to others, may be a reason for their rejection, and for the preference given to the acetous acid.

Having given an account of the various preparations that are generally used for wool, silk, and cotton, and of the basis applied for the reception of the colouring matter, let us next take a view of the particular preparatory operations which are practised in the process for dyeing the Adrianople or Turkey red, on cotton; and to these also add a detail of the process itself. It is proper to premise, that all the wooden vessels employed should be made of deal, or of some white wood, free from astringent matter; and that the most convenient quantity for operating on, in proportion to the ingredients used in the several operations, is sixty-six pounds of cotton.

From sixty pounds of Alicant barilla, a ley is drawn, by means of soft water, amounting to sixty gallons; and then, by pouring on of fresh water, a second ley is formed, measuring forty gallons; after this, a third ley is also extracted from the same barilla, the quantity of which should be about fifty-two gallons.

A liquor is also prepared, consisting of four gallons of sheep's dung, collected after it has been excreted from the animal, and before it has been exposed to rain, dissolved in twenty gallons of water, and strained through a hair-sieve, to separate from it the grosser parts.

These preparatory measures being taken, the first operation consists in adding nine pounds of Gallipoli oil to eight gallons of the second barilla liquor; this forms a kind of soap, to which are to be added twenty-four gallons of the first barilla liquor, twelve gallons of the dung-liquor, and forty-eight gallons of soft water. Into this liquor, when nearly of a scalding heat, the cotton is to be put; room being made for it by taking out about twenty gallons of the liquor, which is to be gradually returned into the pan, in proportion to the waste by evaporation; and the whole is to be kept boiling during five hours. After which the cotton is taken out of the pan, suspended over it to drain, and then well wrung, washed in clear water, and hung on smooth poles to dry, either in the open air, or in a stove, but the former is to be preferred if the weather be fair.

The liquor wrung out of the cotton is to be preserved, together with the remainder in the pan, for a future operation; and, at this time, sixteen gallons of soft water are to be added to the dung-liquor.

The second operation consists in pouring three pounds and a half of Gallipoli oil into a bucket containing four gallons of the second barilla liquor, and adding this mixture to six gallons of the first barilla liquor, and four gallons of dung-liquor. Of this composition two or three gallons are to be put into a tub, and in it about a pound and a quarter of the cotton is to be well soaked, and afterwards wrung, but not too closely, over a tub kept for that purpose. A similar portion of cotton is then to be treated in the same way; and so on, till the whole has passed through the mixture; adding about a pint, or three half pints, of liquor, on the immersion of every fresh parcel of cotton. The cotton is then to be thoroughly dried; which it must also be after the subsequent operations; and these are to be conducted in the same manner, with respect to the manipulations, as the present one.

In the third operation, the liquor which had been wrung out of the cotton is to be poured back into the tub in which the soaking has been performed; and to this are to be added, of Gallipoli oil three pounds and a half, and of the second barilla liquor, dung-liquor, and first barilla liquor, four gallons each. After this operation, the dung-liquor is to be strengthened, by the addition of about two handfuls of sheep's dung, diluted with a little water.

The fourth operation is similar to the third: the liquor which remains is to be set aside, for the purpose of mixing with the residuary liquor after the eighth operation; to be used for other cotton, in any subsequent process.

The dung-liquor is omitted in the fifth operation; and the mixture employed in the three following operations is called the white liquor, to distinguish it from that used in the three preceding parts of the process, which, from the colour imparted by the dung, is named the green liquor.

The same quantity of oil as before is to be mixed in a bucket with four gallons of the second barilla liquor, and poured into a tub, where are to be added to it, three gallons more of the same liquor, and four gallons of the first barilla ley.

About four gallons of this liquor remain after the wringing, and these are to be added, in the sixth operation, to the same quantity of oil, first mixed with four gallons of the second ley, and then with two gallons (more or less, in proportion to the quantity of white liquor remaining after the preceding operation) of the same ley, and four gallons of the first.

In the seventh operation, the quantities of all the ingredients are the same as in the sixth. The residuum of the white liquor, after the three last operations, will be about eight gallons, and is to be preserved, to be used in the fourteenth operation.

The eighth operation consists in heating the third barilla liquor, amounting to fifty-two gallons, to about the warmth of new milk, removing it, when thus warmed, from the copper to a tub, immersing the whole of the cotton therein, and suffering it to remain for twelve hours, or longer. It is then to be taken out, and laid on a cloth, spread on four or five sticks placed across a large tub, into
which

which the liquor drains, as it runs from the cotton. The cotton is then to be well wrung, and afterwards thoroughly washed, that no loose oil may remain, which would be injurious to the next operation.

The wringing tub and peg are now to be well washed, and a fresh set of poles used; for if any oil were to come into contact with the cotton, in the next parts of the process, it would receive a blackish tinge in the dyeing.

The galling forms the ninth operation. Sixteen pounds of galls, or, if the blue galls be used, somewhat smaller portion, are put into twenty-four gallons of water, nearly boiling. The liquor is then brought to boil, and the ebullition continued for fifteen minutes; but, as soon as the boiling commences, the fire should be withdrawn, as the heat already received will keep it up for a sufficient time, and the galls will not settle if it be too violent. The liquor is to be carried to the wringing-tub, in the quantity of three or four gallons at a time, according as it is soaked up by the cotton, till one half of it has been thus employed; and the cotton is to be worked in it, as hot as possible, by means of a stick passed through the skains. After this it is to be dried, either wholly or in part, in the open air; if it cannot be thus completed, as rain would, in this state, and especially as the cotton approaches to dryness, be highly prejudicial, the drying must be finished in a stove. The liquor which has been wrung out is to be added to the remaining half in the copper.

For the tenth operation, this remaining decoction of galls is to be heated, the thick sediment at the bottom being previously separated by a hair-sieve, and the cotton again treated as in the ninth operation.

The eleventh operation is the aluming of the cotton. Thirty pounds of Roman alum, finely powdered, are put into sixteen gallons of water, gradually heated, and continually stirred; as soon as it becomes so hot that the operator can just easily bear his hand in it, the fire is to be removed. Six gallons of the first barilla liquor are then to be added by degrees, and the whole agitated till the solution is complete. The cotton is to be placed in the wringing-tub, about three gallons of the alum-liquor poured on it, and, in proportion as it is soaked up, more is to be added, till about one half of it is employed. The cotton, having been thoroughly worked in the liquor, is to be well wrung and dried, and the portion which is wrung out is to be returned to the remainder in the pan, and used in the twelfth operation, which is performed exactly in the same manner as the eleventh; after which the dried cotton is to be well washed, by handfuls, in running water, the workman holding in each hand about twenty ounces of cotton, for two minutes. Each portion is then wrung, and separated; washed and wrung again, and laid upon a coarse cloth. The whole is then carried up from the river, wrung a third time, and hung to dry. The cotton will now be ready for the thirteenth operation, in which the colouring substance is applied to it.

The cotton is first divided into four equal parts, each of which is to be dyed separately; and these are subdivided into skains, or parcels, of about a pound and a quarter each. The copper pan is then to be filled with water, within about six inches of the top, and twenty-six pounds of Smyrna, or rather of Cyprus, madder added to it. As soon as the water becomes milk-warm, fourteen pounds of sheep's blood, as fresh as it can be procured, are to be stirred into it. When the

the liquor is so warm that the workman can just bear his hand in it, one fourth part of the cotton is to be put into it, suspended on sticks, by means of which it is moved backwards and forwards in the pan every five minutes; and the skains are to be inverted every ten minutes, so that they may receive the dye equally in every part; this business is continued for about fifty minutes. The cotton is then hung on five sticks only, and so suspended by strings as to be wholly immersed in the liquor, which is now made to boil, and continued boiling for forty-five or fifty minutes. A white froth, which about this time appears on the surface, is a sign that the matter is exhausted of its colouring matter, and that the cotton can receive no benefit, though it will get no injury, from continuing longer in the liquor. It is then to be withdrawn, carried to be well washed in the river, or wash-wheel, and then wrung and dried.

The other three-fourths of the cotton are then to be successively dyed in the same manner; fresh ingredients being used for each parcel.

The fourteenth operation is represented as highly essential to the success of the process; should it be omitted, the colour, it is said, would not only be so unfixed as to lose much in the subsequent operation, but would likewise require more time for the enlivening. About eight gallons of the white liquor, which remained after the seventh operation, and were directed to be reserved, are now to be mixed with four gallons of the first barilla ley. Two gallons of this mixture being put into the wringing-tub, the whole of the cotton is to be washed in it; adding more liquor in proportion as it is soaked up by the cotton, which is afterwards to be wrung and dried.

To this succeeds the fifteenth and last operation; viz. that of enlivening or reviving the colour. The copper pan being about half filled with water, twenty-eight or thirty gallons of the liquor remaining after the first operation are to be added, so that the liquor may reach to within six inches of the top. When the liquor is nearly boiling, the cotton is to be put in, being previously formed into parcels of about two pounds and a half each.

The cotton is to be well pressed down in the pan, and confined by sticks. The pan is covered with a wooden lid, having a small hole, through which the small portion of cotton, reserved for that intention, may be occasionally withdrawn, in order to observe the progress of the operation; this hole has a moveable cover. The lid is then to be secured by a strong cross of wood, with a straight piece over it; and the sides made close, so as to confine the vapour, by laying round the edges of the lid a quantity of damp linen cloth. The fire is then to be raised, so as to make the liquor boil, and the boiling is to be continued for nine hours.

The process is finished by taking the cotton out of the liquor, wringing, and drying it; but the drying is never to be performed either in a stove or in strong sun-shine. The colour will be most brilliant if the cotton be dried in the shade, with a free access of air.

THE INSTRUCTIVE NATURALIST, No. IV.

OF NUTRITION AND SECRETION.

NUTRITION is the function which assimilates the food in the several parts, and which finishes the process already begun in the stomach, in the lungs, and the vascular systems. In perfect animals some of the stages of this process are distinctly marked. The chyle, which has some resemblance to milk, is the work of the alimentary canal: it undergoes some new changes by the action of the lacteals and of their glands, when they exist. In the course of circulation it passes along the respiratory organs, and is mixed with oxygen or some other gas: by this mixture, the consequent heat, and the action of the vessels, it is turned into blood. The blood, when examined, spontaneously separates into three parts; an albuminous part or a serum, a coagulable lymph, and red globules. The two first are analogous to the white parts of an egg, by which the chick in ovo is nourished; the globules have some resemblance to the yolk, which serves afterwards as food to the chick in the more advanced period of life. The three parts contain each a variety of principles which are originally composed of gases: these principles, conveyed through vessels of various forms, of various diameters, and with various degrees of motion and of heat, and all along varying as they pass, arrive at last on the confines of the parts which are wrapt up in a cellular tissue or some other membrane. The tissue or membrane gives a new change; the parts nourished perform the office of secreting organs; and, as the action of the vessels is varied according to the place to which they are tending and the parts which they enter, we partly see the manner in which bone, muscle, cartilage, and nerve, are all secreted from a common mass.

In worms and polypes, the function of nutrition is after digestion carried on almost entirely by the cellular tissue; and in plants by a tissue cellular and vesicular. In all living bodies the cellular tissue, besides giving a form to the parts, and besides preventing friction and cohesion, certainly performs some important office. Many have thought it the organ of nutrition; and it surely is one of the organs employed in assisting to assimilate the nutritious fluid. But it should be remembered, that all the parts of the living body are assimilating organs; that each part assimilates for itself; and that the stomach, the respiratory organs, the vessels, and nerves where they exist, are assistant to the whole and to one another.

It is singular how any should have imagined that the nerves are peculiarly the organs of nutrition, or that growth should be owing to the addition of some organic and vivifying particles pre-existing in the food. These physiologists have not demonstrated the existence of nerves in all living bodies; and these organic and vivifying particles have as yet been discovered but in their fancy. Dr. Monro has proved, that the limb of a frog can live and be nourished, and its wounds heal, without any nerves: and Mr. Hunter has given many curious instances of a living and nutritious power in the blood.

In plants and animals, the assimilating power has always certain limits prescribed to it: its influence is very generally confined to the sort of food congenial to the species: and its strength is varied

according to circumstances; as the age, the habits, and the state of health. Those which are young assimilate faster than those which are old; and one species, which may partly be owing to the nature of their food, will assimilate much faster than another. Certain worms that feed on animal and vegetable substances will, in twenty-four hours after their escape from the egg, become not only double their former size, but will weigh, according to Redi, from one hundred and fifty-five to two hundred and ten times more than before. Most oils are of very difficult assimilation; and those which are essential will often resist the long-continued and the varied action of the living organs; will mingle with the parts, and, undecompounded, communicate their flavour.

An assimilating power is not peculiar to living bodies; it is observed in ferments and contagion, and is so obvious with respect to flame, which is neither living nor organized, that whole nations, who have seen it feeding on inflammable substances, have been disposed to think it was animated, to call it the principle of life itself, and to pay it a kind of religious homage as the proper emblem of that Being by whom the whole universe is upheld.

In living bodies nutrition is only a species of SECRETION, which is a function in which a part is separated from the whole, and generally with some change of its qualities. In the case of nutrition it was observed, that all parts secrete for themselves; and that some few, as the lungs, the stomach, the vessels, and the nerves, officiate besides for the general use of the whole system. If all the ingesta were to remain and to be assimilated, the body would go on continually increasing. But living bodies are constantly in a state of waste and repair. In most animals part of the ingesta is carried off by evacuation, without having entered the mouths of the absorbents; part, which enters the absorbents and veins, is thrown off by exhaling arteries or the urinary passage: and experiments with madder prove that the lymphatics, besides originating from all the cavities and carrying back the lubricating fluids, do enter the substance of the hardest bones, and convey particles that had been assimilated back into the blood.

This office has not been generally ascribed to the absorbents; nor has it been very generally supposed that the blood receives the excrementitious matters of the system, and that one intention of the circulation was either to return them for re-assimilation, or to discharge them by exhaling vessels or by the kidneys. Decayed parts, however, are discovered in the feces evacuated by the intestines, in the clouds, the sediment, and colour, of the urine, and by the smell of the perspirable matter. The two last, on certain occasions, and for some time, have often supplied the place of one another; and all the three, the feces, the urine, and perspirable matter, we have reason to believe are remarkably distinguished by two kinds of odour; the one peculiar to the whole species, the other peculiar to the individual. By the perspirable matter which adheres to the ground, and of which the odour is diffused by moisture, the dog not only distinguishes a man from any other animal, but is able to trace his master through a crowd.

The natural evacuations of plants, and of some few animals which feed by absorbents, are all by perspiration or exhaling vessels. The urine in quadrupeds is before emission collected in a vesicle, and
thence

thence carried off by the genital organ. In birds, and in a number of fishes, the ureters empty themselves into the rectum, and their contents are evacuated along with the feces.

Besides being used to denote the function, the word secretion is sometimes employed for the matters secreted. In this sense there are various secretions. Besides the feces, the urine, and the sweat, and the vapour from the lungs, which are excrementitious, there are secretions which answer useful purposes in the system. Of these the most important and general are the bile, the saliva, the gastric juice, and the pancreatic, which assist in digestion; the lymph and the fat, which lubricate the parts; the mucus, which protects them from acrid substances; the nervous fluid, which forms a very conspicuous link between body and mind; the seminal fluid employed in generation to propagate the species; and the lacteal, intended for some while to support the young after they emerge from the fetal state.

The saliva is a fluid that mixes with the food in the time of mastication. In man it is secreted from the parotid, the sublingual, and submaxillary, glands; it is watery and somewhat viscid; it is found to retard and moderate fermentation; it has sometimes a tendency to form calculi like the urine. By these concretions it incrusts the teeth and sometimes obstructs the salivary ducts. It is the seat of the rabies canina.

Upon first examination the gastric liquor seems to possess a solvent power upon animal and vegetable substances without any great preference of affinity. The reason is, it varies according to the nature of the aliment; "it is sometimes acid, sometimes insipid. Brugnatelli has found (says Chaptal) in the gastric juice of carnivorous birds and some others a disengaged acid, a resin, and an animal substance, united with a small quantity of common salt. The gastric juice of ruminating animals contains ammoniac, an extractive animal substance, and common salt. In our time the phosphoric acid has been found disengaged in the gastric juice" of the graminivorous kinds.

"The bile secreted by the liver is glutinous or imperfectly fluid like oil, of a very bitter taste, a green colour inclining to yellow, and froths by agitation like the solution of soap. Its constituent principles are water, a spiritus rector, a coagulable lymph, a resinous oil, and soda. The resinous part differs from vegetable resins; because these do not form a soap with fixed alkalies; because they are more acrid and inflammable; and because the animal resin melts at the temperature of forty degrees, and acquires a fluidity similar to that of fat. From fat it differs in not being soluble in cold alcohol, in which respect it approaches to spermaceti, which alcohol cannot dissolve without heat.

Bile, like other soaps, removes spots of oil from these substances to which they are adherent; when its passages are obstructed the motion of the intestines becomes languid. It is neither alkaline nor highly putrescent. In putrefaction it yields something of a musky colour; the fossil alkali precipitates from it a green sediment; and with distilled vinegar it produces a mixture neither acrid nor sweet. Like saliva and urine, it has a tendency to form concretions which are called biliary calculi or gall-stones. They are sometimes found of an irregular texture, of a brown, black, yellowish, or greenish, colour.

They sometimes consist of transparent chrySTALLINE laminæ, like mica or talc, and are sometimes radiated from the centre to the circumference. They are always inflammable, of a more solid consistence than the generality of animal oils, and resemble spermaceti both in their solidity and chrySTALLIZATION; they are soluble in ardent spirit when assisted by a moderate heat: the warm solution, when filtered, deposits by cooling a number of laminated white brilliant crystals, such as Poulletier de la Salle found in the bile, and which have been compared to the salt of benzoïn, the concrete acid of borax, and to spermaceti. Many of their characters indicate that they are a substance of the same nature with the last-mentioned. Fourcroy found that the substance of which these crystals are composed exists not only in the crystallized gall-stones or bile; he observed it to a very considerable degree in a human liver which had been exposed to the air for several years, and had lost its volatile parts by putrefaction. He detected it also in a saponaceous form in bodies which had been many years buried under ground; and lately Dr. Pearson has artificially converted the muscular fibre into a substance of a similar kind, highly inflammable, and resembling spermaceti. The means which he uses is digestion in water; and the process supposes a previous acquaintance with what is common and what peculiar to the fibre and the fat. He maintains that the fibre is entirely composed of carbone, oxygene, hydrogen, and azote. In a high temperature these are decomposed, or at least separated, without producing fat. But, when the fibre is kept in water in a low temperature, the carbone unites with the hydrogen of the water, and forms a fat resembling spermaceti, and highly inflammable. Part of the oxygene, too, uniting with azote, forms the nitric acid; and part of the azote uniting with the hydrogen constitutes ammonia; so that three substances are thus formed.

The pancreatic juice resembles the saliva, and was examined in the last century, with a good deal of care, by De Graaf and Swammerdam. It has often been observed forming stony concretions. De Graaf was of opinion, that calculi might be formed in all glands. He had seen them above twenty times in the pineal gland, that was long thought the residence of the soul:—he says, too, that they occur more frequently in the pineal gland of Frenchmen than of Dutchmen; and very pleasantly assigns this reason, that the volatile spirit of a Frenchman requires more ballast than that of a Hollander.

The lymph consists chiefly of water, but, like the serous part of the blood, contains a substance which is coagulable by heat, by acids, and by spirit of wine. It is found in the cellular membrane, in the ventricles of the brain, in the pericardium, on the surface of the pleura, in the abdomen, in the bursæ mucosæ, and in the joints under the name of synovia, where it has more than an ordinary degree of viscosity and of the lubricating quality. Sometimes, when it stagnates in the sheaths of the tendons and bursæ mucosæ, it acquires a thickness, and forms indolent transparent tumors, which become at last gelatinous. It is secreted chiefly by arteries.

Animal fat is a substance of a nature similar to those oils which are called fat in the vegetable kingdom. Its colour is usually white, sometimes yellow, and its taste insipid. Its consistence is various in different animals. In cetaceous animals and fishes it is nearly fluid: in carnivorous animals more fluid than in the fergivorous: in birds,
finer,

finer, sweeter, and more unctuous, and generally less solid, than in quadrupeds. In the same animal it is more solid near the kidneys and under the skin than in the vicinity of the moveable viscera. As the animal grows old it becomes yellower and more solid; and in most animals is more copious in winter than in summer. In man and some other animals, it is collected in particular follicles of the cellular membrane, accumulated in great quantities in the groin, in the axilla, in the epiploon around the kidneys and around the blood-vessels: it is likewise secreted on the surface of the skin, which it protects from acrid substances, and where it sometimes concretes, often from a want of cleanliness, in the form of small worms. In cetaceous animals and fishes it is generally disposed in certain reservoirs, such as the cavity of the cranium and the vertebræ; in some it is chiefly confined to the liver; in serpents, insects, and worms, to the viscera of the lower belly, where it is disposed in small lumps, and only a small quantity found on the muscles and under the skin: in frogs it is collected in certain bags which diverge, as it were, from a common trunk, and seem like appendages to the ovaria and testes. In many places it seems to be secreted by organic pores, and under the surface of the skin by glands. It is accumulated from a diminution of perspiration, from the nature of the aliments, from morbid affection, and from idiosyncrasy. It is of the same nature as the fixed oil of plants; and Lorry has found a striking analogy between it and the bile.

It is a bad conductor of heat, and preserves the warmth of those regions where it is situated. It is more adhesive and less apt to evaporate than water, and is therefore a better lubricating fluid. When re-absorbed, it counteracts the saline impregnation if too copious; and its nutritive power is as three to one when compared to that of the muscular fibre. These properties may partly serve to explain its uses around the several branches of the blood-vessels in those parts which require warmth, and in those which are anywise exposed to motion. They will likewise account for its being more copious in winter than in summer; and for its being found in great quantities in the marmot, the dormouse, in the bear, and those animals in general which are constrained to a long abstinence. It forms sometimes steatomatous tumours, and contains the sebatic acid, which acts readily on lead, copper, and iron.

The vegetable fat is contained chiefly in the fruit; and is known by the names of fat-oil, sweet-oil, and oil by expression. It freezes in different degrees of heat, and varies according to the nature of the plant by which it is afforded.

The mucus is more viscid than the lymph, and is not coagulable by fire or alcohol. It is mild, not disposed to corruption, nor soluble in water. This secretion is performed by glands. These glands, in the pulmonary phthisis, secrete often a mucus that resembles pus, and occasions a suspicion of ulcers where there are none. Mucus is found in the nose, through the whole length of the alimentary canal from the mouth to the anus, in the aspera arteria, in the bronchia, in the kidneys, ureters, bladder, and most of all in the urethra. It forms hard stony concretions sometimes in the lungs.

The seminal fluid has been seldom the subject of chemical analysis. It is heavier than water, soluble in urine, deliquesces in air and with heat, it hardens with the fixed alkali, and is not coagulable by alcohol.

In the system in which it is secreted, it affects the passions, the manners, and the voice, the state of the muscles, the secretion of fat, and the growth of the hair. In many fishes this fluid is contained in a sort of bags. In most animals it is secreted by glands, which are called testes, and is accumulated in the vasa deferentia, or where they exist in the seminal vesicles. Of these vesicles Swammerdam observed long ago, that in the scorpion they were probably "adapted by nature to secrete a seminal matter different from that supplied by the testicles; they are largely (he says) supplied with glandules to answer that purpose, and consist of a considerably thick and spongy substance." Mr. Hunter since has endeavoured to shew that they secrete a particular fluid in all animals.

So little are we acquainted with the nervous fluid, that some have doubted of its existence. The discovery, however, of Galvani, and the numerous experiments that have since been making on animal electricity, leave us not without all hope that something yet may be known of its properties that will greatly illustrate several phenomena in the animal economy.

The lacteal secretion is generally confined to one sex, and is peculiar to the class of mammalia, though something similar may perhaps be secreted in the crops of pigeons.

It would be impossible here to enumerate or to tell the uses of all the different kinds of secretions in living bodies. We cannot enumerate all that we know without running into tedious detail. The essential oils, the camphor, the gums, the balsams, the resins, and many others, are various secretions of the vegetable kingdom. Each species of plant and animal has generally some peculiar secretion; and this secretion in the individual has often some distinguishing quality, discoverable by taste, by colour, or by smell. These different secretions have likewise each their particular uses. We know the intention of the oily juice with which the bird dresses its feathers, of the glutinous fluid of the fish, of the viscid mucilage of the snail; we see the purpose for which the viper sometimes employs its virulent humour, and for which the scuttle-fish ejects its ink: but yet we know only in part.

The difference among the various secretions of the same system seem principally owing to a difference of stimulants, and to some difference in the action, the form and the irritable power of the secretory organ. Passions of the mind very often affect the secretions; and it frequently happens that passion and medicine affect one secretory organ and not another. It is therefore probable that the organs of secretion, and the smallest fibre is an organ of this kind—we say, it is probable that the organs of secretion, like the eye, the ear, and all the different organs of sense, are each affected in some measure by peculiar stimulants; as the stomach by hunger, the fauces by thirst, and the genital organs by venereal orgasmus.

Fermentative mixture, and some original impregnation of the organs, have also been brought to explain the several phenomena of secretion. We conclude with observing, that however much the various fluids of living bodies may differ in appearance, chemical analysis has generally reduced them to a water, a gluten, a saline impregnation, and an oil.

CURIOUS PARTICULARS OF THE ZOOLOGY OF THE ISLE OF WIGHT.

THE *fauna vectensis* does not add much to the zoology of Hampshire. It is indeed marked by some singular omissions in the chain of quadrupeds common in every other part of England. The fox, who has for ages been the terror of the farmer, and the delight of the sportsman throughout Britain, was never yet found in the Isle of Wight. The harmless badger also, and the fetid fitchet, or polecat, are strangers to this district; which, from the absence of these animals, and its insular situation, appears to be the best calculated for the production of game of any place in Great Britain. And indeed it has always been famous for its hares, pheasants, and partridges.

The hare of the Isle of Wight furnishes good and constant sport to the hunter during the season. It is, I think, rather smaller than its brethren on the continent, but swift and strong. The inequalities of the island make this spot an excellent residence for the animal, and give it considerable advantages over its pursuers. The long muscular hind legs which it has, are well calculated to mount the steep downs of the island with uncommon fleetness; and it not unfrequently escapes, by distancing both hunters and dogs, at these rapid ascents.

As the hare is an animal of surprising fecundity, and secured from the attacks of the fox and polecat, by the absence of these destructive vermin in this part, we may naturally suppose they would be found in very great plenty throughout the island. And indeed this was the case till within these thirty or forty years; but as a Roman taste for the animals has arisen among us, and they are considered as tit-bits by modern epicurism, the midnight poacher finds it well worth while to employ all his skill, and run every risk, in the capture of the hare; a practice which of course must thin the breed extremely. There remain, however, sufficient for the sport of the gentlemen of the island.

There are few disagreeable reptiles in the island. Such as occur, are found in the lower sandy parts of it; the other spots being freed from them by the elevation and exposure of their situation. Many vipers indeed are met with in the chalky and stony places, and the largest I ever saw, I had nearly trodden upon, in the parish of Wootton, in the outskirts of Coombly wood, in August, 1792. Had my foot, however, come in contact with this animal, no injury could have ensued to me from the pressure, as it was utterly incapable of revenging the insult. This incapacity had been produced by its voraciousness; as was evident on an examination of the reptile. We then found that it had attempted to gorge a frog, (at least three times as large in circumference as the thickest part of its own body,) but, being unable to accomplish the task entirely, one of the legs and thighs of its prey continued to depend from the viper's mouth, and effectually prevented it from crossing the jaws and excluding its poison. The animal indeed (as is the case with all the serpent kind after satisfying their voracity) was in a state of torpor, which rendered it apparently insensible of our approach or observation, and unable to express any tokens of indignation when we destroyed it. On measuring

firing it when dead, it was found to be exactly twenty-nine inches long.

On contemplating this animal, one of the most remarkable circumstances relating to it appears to be the faculty it thus possesses, of extending its jaws, throat, and stomach, so considerably, as to render them capable of admitting a substance much thicker than any part of its body. In the singular conformation of its parts, to accomplish this purpose, the wisdom of Providence strikingly manifests itself. The head of the viper is broad and flat, having a wide mouth of very uncommon and disproportionate magnitude. This permits the jaws to gape to a great extent; but the aperture would still be insufficient for the admission of the animal's prey, were not the capability of its distension increased by the following nice contrivance. The jaws are not united together at the bottom, as in the human mouth, by a process resembling a pair of hinges; but connected by a strong muscle, the elasticity of which is such, as to keep the features firm when not in action, and to allow their being stretched to an immoderate extent, when the size or form of the animal's food requires it. The gullet or throat receives the aliment from the mouth, and, being very capacious and elastic, easily accommodates itself to the magnitude and figure of it. From hence a part only immediately finds its way into the stomach, a receptacle by no means so large as the gullet; here it continues till it be reduced by the action of digestion into chyle, which, going off in the natural way, affords room for the remaining parts to be absorbed by the stomach, and digested.

These reptiles are viviparous, but fortunately for mankind not very prolific. The poison of their bite is fully established; and the effects of it, if there be no speedy application to the wound, extremely frightful, and many times fatal. The simplest and most ready cure, in case of an injury from a viper, is a brisk fomentation of the wounded limb with warmed fallad-oil; and taking about a gill of the same liquid internally.

The only insect of any curiosity, which my occasional walks through the island have given me an opportunity of discovering, is the *gryllus talpa*, or mole-cricket. The character and manners of this little creature, which is perfectly inoffensive, are well deserving notice, particularly as its homely, and indeed hideous, figure, are apt to excite emotions of dread and abhorrence, neither of which need be entertained against it. The only one I have seen in this part of Hampshire occurred in a wet meadow in the heart of the island. It had been dug up by a lad who was grouting for earth-worms; and had filled him with astonishment and apprehension. The spade was just lifted for dividing the harmless insect in twain, when my presence and intreaty prevented the meditated blow.

On examining this insect, it appeared to be of a very dark brown colour, and little more than two inches in length. Its body was scaly; furnished with two long, pointed, wings, and as many hairy tails. The most remarkable parts about it, however, were the fore-feet, which have some resemblance to a human hand, and are admirably formed for making those subterraneous excavations wherein the animal resides, and deposits its eggs. Strong, webbed, and a little incurvated, the mole-cricket works with its paws at a prodigious rate, and will burrow its way through a whole ridge of leguminous plants (of the roots of which it is very fond) in the course of a

single night. With these instruments, also, its neat habitation (which is a room about the size of a hen's egg) is quickly formed; and guarded with various winding passages, and curious approaches to it. This domicellium is generally, in the summer time, placed within six inches of the surface of the ground, and herein the female lays her eggs, from one hundred to one hundred and fifty; but toward winter, instinct, ever faithful to its office, informs the little being, that in order to secure his tender offspring he must get deeper into the soil, and retire from the influence of the frost. Again therefore he sets to work, and in a short time completes, with his little webbed feet, a commodious hybernaculum, about fourteen inches below the surface of the ground. Hither he retires with his family, and patiently waits for the return of genial suns; and warmer seasons, when he again takes possession of his summer abode.

The chief food of the mole-cricket consists of roots and vegetables, for which he sometimes travels at night, by the assistance of his wings, to a considerable distance. Before morning he generally returns to his subterraneous habitation, and, wonderful to tell! is found (by the minute investigations of naturalists and anatomists) to be employed there during the day chiefly in ruminating; or chewing the cud.

The fish found on the coast of the island are chiefly such as frequent the southern shores of Britain. Now and then, indeed, these innoxious tribes are disturbed by the shark, who is either brought from the Baltic, or the tropics. In these cases he comes,

—Lur'd by the scent
Of streaming crowds, of rank disease and death;

following vessels, the crews of which are unhealthy, and afford him luxurious meals by their occasional dissolution. Sharks have been shot in the strait that separates the island from the opposite shore, and been seen even within the harbour of Cowes. They make, however; but a short stay in this neighbourhood; and either return to the regions from whence they came, or go more to the westward, in search of the droves of pilchards on the Cornish coast.

The porpoise also is perpetually seen on the coasts of the island, 'tempesting the deep' with its unwieldy gambols. It is a very disgusting fish to the eye, being almost black in colour, with a head like a hog, and from three to six feet in length.

During the whiting and herring season, it is very amusing to watch these animals in pursuit of their food, which is composed of the smaller fish; and to remark the various arts by which they accomplish the great end of satisfying their voracity. An excellent naturalist compares their exertions, at this time, to those of a pack of hounds after a fox; and indeed there is a great resemblance in the operations of both. Their eagerness also, when thus engaged, equals that of the dog, and frequently renders the porpoise so blind to its safety, that he will dash headlong upon shoals from which he never can recede, rather than give up the pursuit. It is either by an accident of this nature, or by an injury or indisposition which prevents him keeping the seas, that the porpoise is now and then forced on our shores, and found either dead or expiring. When this happens, the carcase proves to be no contemptible treasure to the finder; for the quantity of fat with which the flesh is surrounded, being well-

boiled, is converted into a very excellent and valuable oil. The lean also of this fish is in some parts of the world used for the table; but proves, to a palate not habituated to it, a very rank and disagreeable viand.

The mutations of fashions and tastes, however, in the line of eating, have been not a little whimsical, even in our own country; since the porpesse, which we now turn from with loathing and abhorrence, was eaten with avidity by the old English epicure. Ancient cookery exhausted all its art in mixing sauces for this delectable morceau; and there was no entertainment of any magnificence till the sixteenth century, at which the porpesse, either bodily or in junks, did not find a respectable place.

There is another fish of a curious form and singular history, which is often fished up by the dredgers on the island shores. This is the *loligo*, or great cuttle-fish, whose bones are the well-known white oval substances, found on the beach in many parts of the island. This aquatic animal, which the naturalists place in the *vermes* class, exhibits a very hideous and deformed appearance. It is from eighteen inches to two feet in length, and covered with a thin dark-coloured skin. To the eye it seems to be of the consistence of jelly; strengthened, consolidated, and defended, as it were by a bone on the upper part of the back. For the convenience of feeding itself, it possesses eight arms, placed with great regularity round its mouth, each of which is thickly set with a multitude of small concave discs, that enable it to adhere, with inconceivable tenacity, to rocks or stones when it chuses to be quiescent. Exclusive of these arms it has two *tentacula*, or feelers, of considerable length, which it is able to extend or contract at pleasure. With these it seizes upon the small fry that compose its food, which having entangled, they immediately commit the prey to the management of the eight arms, while themselves are again extended in search of further plunder. The eyes are seated immediately beneath the *tentacula*; and a little below them is discovered a curious mouth, which in shape and substance nearly resembles the beak of a parrot.

As this fish is formed without any external weapons of defence, and by no means made for contest or exertion, it would fare but ill amid the dangers of the deep, and the numerous enemies that surround it, had not Providence wisely afforded it a means of safety, which enables it to escape mischance, and continue the propagation of its kind. This arises from a secretion of a black fluid, nearly resembling the best ink, contained in a bladder under the belly of the fish.

No sooner does this animal perceive himself to be in danger, from the pursuit of an enemy which he can neither outswim nor contend with, than he emits (by the anus) a certain portion of his dingy liquor; this immediately discolours the circumambient waters, and precludes the pursuer from seeing his destined prey, which, wrapped in impenetrable darkness, quietly sinks to the bottom, and there remains till the danger be overpast.

These remarkable means of self-preservation did not elude the observation of the ancient naturalists, who all make mention of them; and particularly Oppian, in the following manner:

‘Th’endanger’d cuttle thus evades his fears,
And native hoards of fluid safety bears.

A pitchy

A pitchy ink peculiar glands supply,
 Whose shades the sharpest beams of light defy :
 Pursu'd, he bids the fable fountains flow,
 And wrapt in clouds eludes th' impending foe.
 The fish retreats unseen, while self-born night
 With pious shade befriends her parent's flight.'

The *launce*, *ammodytes*, or sand-eel, is a delicate little fish, found on the sandy shores of the island. It being both a good bait for other species, and excellent eating in itself, the fishermen take some trouble in procuring them. At the recess of the tide, they are to be found about fourteen inches below the surface, and are easily turned up by a light spade, or trident fork. The islanders call them the sand-sprat, from the place of their residence; into which they bore with great dexterity and dispatch.

Here also is found the *filiqua*, a species of the *solen*, or razor; so called from the exact resemblance of its shell to the haft of that instrument. I believe the islanders are unacquainted with the excellence of this fish; since I did not find they ever made a practice of taking them, although it is evident they are sufficiently plentiful on the sandy parts of the coast, from the numbers of cast shells which occur, and the holes of their habitations visible at low water.

The slender form of this shell enables its inhabitant to sink it easily into the sand, which it does in a perpendicular direction, to the depth of nearly two feet. When the fish requires food, it ascends from this dark retreat, and discovers one end of the shell a few inches above the surface of the sand; from this the body is seen to be protruded, and actively employed in the search of such minute insects as constitute its prey.

The *filiqua* is only to be caught at the recess of the tide; and so vigilant is it in providing for its own safety, that it requires great circumspection to surprise it even then. In this case, the fisherman takes some salt, and places a small quantity of it round the perforation in the sand wherein the fish resides. This quickly melting, penetrates to the *filiqua*, who is led from thence to believe the tide is risen, and accordingly elevates himself to the surface to seek for food. A moment, however, convinces it of the deceit; and, if the fisherman be not extremely active, his destined prey escapes him, by sinking instantaneously into its dark and deep retreat, from whence it is not a second time to be allured.

The *mytilus edulis*, or eatable muscle, is found in many parts of the island shores, but appears not to be regarded much, from the opinion of its possessing some noxious, nay poisonous, qualities. The idea, however, is slanderous and without foundation, as the fish itself is a wholesome and nutritious food. What occasions the disagreeable effects sometimes experienced after eating muscles, is swallowing inadvertently the little mass of hair or silky web, found in the middle of the fish, with which it attaches itself when alive to rocks and stones. This is very pernicious and highly indigestible, producing that sickness, swelling, &c. which raw silks, cobwebs, or any thing of the same nature, is found, if swallowed, to occasion. The singular conformation of the organs of this marine animal is said to be this: it has a mouth furnished with two fleshy lips; its intestine begins at the bottom of the mouth, passes through the brain, and

makes a number of circumvolutions through the liver ; on leaving this organ it goes on straight into the heart, which it penetrates, and ends in the anus ; near which the lungs are placed, and through which it breathes !

On opening the muscle, there is generally discovered a small crab, called the *pisum*, or pea-crab, who seems to be the voluntary inhabitant of this bivalve. The ancients fancifully imagined, that this minute insect was purposely placed in the shell of the muscle, and other fish of the same class, to assist, by its sagacity, the stupidity of its host, in acquiring food and avoiding danger. When the friendly pair feel inclined to eat, the muscle opens its shells, and permits the little lodger to travel forth in quest of provender. As soon as he has procured a supply, he returns to the sluggish muscle, enters the shell, and divides the plunder with him. But should he, on going out, perceive any of the *polypus* race (the sworn enemies of the *mytilus* tribe) in the neighbourhood, he instantly hurries to his testaceous home, communicates the alarm, and all danger is immediately prevented by the muscle firmly closing his impenetrable shells.

All the submarine rocks and stones on the coast of the island afford protection to the *patella vulgata*, or common limpet ; and to these this fish attaches itself with the most obstinate adhesion. The difficulty of separation indeed is such, that the fishermen are deterred from attempting to collect limpets for sale ; though such as have patience sufficient to disengage them from the places to which they are affixed, are rewarded for their trouble by an extremely good and nourishing viand.

Various species of turbinated shells, chiefly of the *buccinum* or *welk* kind, are picked up on these shores. As the natural inhabitants of these affect the deep recesses of the ocean, the shells are never found with their original possessors alive. It frequently happens, however, that on taking them up they appear to be tenanted by a kind of crab ; the claws and legs of which discover themselves at the mouth or opening of the shell. This lodger is called the *bernard*, or hermit-crab, and curiously exhibits the wonderful operations of animal instinct. As the hinder parts of the hermit's body are tender and naked, unprotected by that shelly covering which its crustaceous brethren possess, perpetual injuries would happen to it, had not nature provided it with a foresight which serves to guard it from external accident. Taught by this, the hermit-crab seeks for the roomy cavity of some forsaken welk, into which it wriggles itself, and there continues till its increased size obliges it to look out for a habitation of greater dimensions. It then leaves its temporary protector, and traverses the coast with patient assiduity in search of another abode, to which when found it attaches itself, as to the former one, by means of a strong hook placed at the extremity of its tail. So kindly has Providence bestowed even on the most minute and contemptible animals, the means of comfort and self-preservation.

The southern shore of the island abounds with crustaceous fish of all sorts. The lobster and crab in particular are found in great plenty, and of uncommon size and excellence. Of the former, I have seen an individual that weighed six pounds and a half ; and I am informed the latter will arrive to an equal magnitude. The plentiful production of this fish on a particular part of the shore, at the back of the island, has occasioned a neighbouring village to be called Crab-niton.

GEOGRAPHICAL

GEOGRAPHICAL DESCRIPTION OF THE RED SEA.

THE Red Sea, or Arabic Gulph, so much celebrated in sacred history, separates Arabia from Upper Ethiopia and part of Egypt. This sea is three hundred and fifty leagues in length and forty in breadth. As no river falls into it of sufficient force to counteract the influence of the tide, it is more affected by the motions of the great ocean than any of the inland seas nearly in the same latitude. It is not much exposed to tempests: the winds usually blow from north to south, and being periodical, like the monsoons of India, invariably determine the season of sailing into or out of this sea. It is divided into two gulphs; that to the east was called the *Ælanitic gulph*, from the city *Ælana* at the north end of it; and that to the west the *Heroopolitic*, from the city of *Heroopolis*; the former of which belongs to Arabia, and the latter to Egypt.

Mr. Bruce, in his *Travels into Abyssinia*, has many observations on this sea, which are worthy of notice.—With regard to the name, he says it was certainly derived from *Edom* or *Esau* the son of *Jacob*; though in another place he says, he wonders that writers have not rather supposed it to have got the epithet of *Red* from the colour of the sand on its coasts, than for other reasons they have alleged. With regard to any redness in the water itself, or in the bottom, which some have asserted, our traveller assures us that there is no such thing. It is more difficult to assign a reason for the Hebrew name of it, which signifies the *Sea of Weeds*; as he never saw a weed throughout the whole extent of it. “Indeed, (says he,) upon the slightest consideration, it will occur to any one, that a narrow gulph, under the immediate influence of the monsoons, blowing from contrary points six months each year, would have too much agitation to produce such vegetables, seldom found but in stagnant waters, and seldom, if ever, found in salt ones. My opinion then is, that it is from the large trees or plants of white coral, spread every where over the bottom of the Red Sea, perfectly in imitation of plants on land, that the sea has obtained this name.—I saw one of these, which, from a root nearly central, threw out ramifications of an almost circular form, measuring twenty-six feet every way.”

Our author has also made many useful observations on the navigation of this sea. “All the western shore (he says) is bold, and has more depth of water than the east; but on this side there is neither anchoring ground nor shoals. It is rocky, with a considerable depth of water every where; and there are a number of sunken rocks, which, though not visible, are sufficiently near the surface to destroy a large ship.” The cause of this, in Mr. Bruce’s opinion, is, that the mountains on the side of *Abyssinia* and *Egypt* are all of hard stone, porphyry, many different kinds of marble, granite, alabaster, and basalt. These being all composed of solid materials, therefore, can part with very little dust or sand, which might otherwise be blown from them into the sea. On the opposite coast, viz. that of *Hejaz* and *Tahamah*, on the Arabian side, the whole consists of moving sands; a large quantity of which is blown from the south-east by the dry winter monsoons; which being lodged among the rocks on that side, and confined there by the north-east or summer monsoon, which is in a contrary direction, hinders them from coming

coming over to the Egyptian side. Hence the western coast is full of funk rocks for want of sand to cover them, with which they would otherwise become islands. They are naked and bare all round, with sharp points like spears; while, on the east-side, every rock becomes an island, and every two or three islands become an harbour. On the ends of the principal of these harbours the people have piled up great heaps of stones to serve as signals: "and it is in these (says Mr. Bruce) that the large vessels from Cairo to Jidda, equal in size to our large 74-gun ships (but from the cisterns of mason-work built within for holding water, I suppose double their weight), after navigating their portion of the channel in the day-time, come safely and quietly to at four o'clock in the afternoon; and in these little harbours pass the night, to sail into the channel again next morning."

The western channel of the Red Sea was chosen, in the days of the Ptolemies, for the track of the Indian and African. These monarchs erected a great number of cities all along the western coast; and, notwithstanding the dangers of the navigation, we do not hear that it was ever abandoned on account of them.

From the observations made by our author on the navigation of the Red Sea, he undertakes to point out a safe passage for large ships to the gulph of Suez, so that they may be able to judge of the propriety of their own course themselves, without trusting implicitly to the pilots they meet with, who are often very ignorant of their profession. This sea, according to Mr. Bruce, may be divided into four parts, of which the channel occupies two, till near the latitude of 26° , or that of Cossair. On the west it is deep water, with many rocks; and on the east it is full of islands, as has been already-mentioned. Between these islands there are channels and harbours of deep water, where ships may be protected in any wind; but a pilot is necessary in sailing among these from Mocha to Suez, and the voyage besides can be continued only during part of the day. Ships bound to Suez without the consent of the sheriffe of Mecca, that is, without any intention of selling their cargo at Jidda, or paying custom there, ought to take in their fresh water at Mocha; or, if there be any reason against this, a few hours will carry them to Azab or Saba, on the Abyssinian coast, where they may be plentifully supplied: but it must be remembered, "that the people here are Galla, the most treacherous and villanous wretches on earth." Here not only water may be procured, but plenty of sheep, goats, with some myrrh, and incense in the proper season.—Great caution, however, must be used in dealing with the people, as even those of Mocha, who are absolutely necessary to them in their commercial dealings, cannot trust them without surety or hostages. Not many years ago, the surgeon and mate of the Elgin East Indiaman, with several other sailors, were murdered by these savages as they went ashore to purchase myrrh, though they had a letter of safe conduct from the shekh.

To such as do not want to be known, our author recommends a low black island on the coast of Arabia, named Camaran, in latitude $15^{\circ} 30'$. It is distinguished by a white house or fortress on the west end of it; where water is to be had in still greater plenty than at Azab; but no provisions, or such only as are very bad, can be procured. If it is necessary not to be seen at all on the coast, the island

of Fooft is recommended by our author as having excellent water, with a faint or monk, whose office is to keep the wells clean. This is one of the chain of islands which stretches almost across the gulph from Loheia to Masuah, and from actual observation by Mr. Bruce, is found to be situated in N. lat. $15^{\circ} 59' 43''$. E. long. $42^{\circ} 47'$. From this to Yambo there is a safe watering-place; and there is an absolute necessity for having a pilot before you come to Ras Mahomet; because, over the Ælanitic gulph, the mountains of Aucha, and the Cape itself, there is often a thick haze which lasts for many days together, and a number of ships are lost by mistaking the eastern bay or Ælanitic gulph for the entrance of the gulph of Suez; the former has a ridge of rocks nearly across it. After reaching Sheduan, a large island, about three leagues farther in a north by west direction, there is a bare rock distinguished by no particular name; but so situated that ships ought not to come within three leagues of it. This rock is to be left to the westward at the distance just-mentioned; after passing which you meet with shoals forming a pretty broad channel, with soundings from fifteen to thirty fathoms; and again, on standing directly for Tor, there are two other oval sands with sunk rocks in the channel, between which you are to steer. Tor may be known at a distance by two hills that stand near the water side; which, in clear weather, may be seen six leagues off. Just to the south-east of these is the town and harbour, where there are some palm-trees about the houses, the more remarkable, as being the first that are seen on the coast. The soundings in the way to Tor harbour are clean and regular; "and, by giving the beacon a small birth on the larboard hand, you may haul in a little to the northward, and anchor in five or six fathom." In spring-tides, it is high water at Tor nearly about twelve o'clock: in the middle of the gulph there is no perceptible tide, but at the sides it runs at the rate of more than two knots in the hour. Tor itself is but a small village, with a convent of monks belonging to those of Mount Sinai. It was taken by Don John de Castro, and fortified soon after its discovery by the Portuguese; but has never since been a place of any consideration; serving now only for a watering place to the ships trading to or from Suez.—From this place there is a distinct view of mounts Horeb and Sinai, which appear above and behind the others, with their tops frequently covered with snow in the winter.

Mr. Bruce next proceeds to consider some questions which may be reckoned matters of curiosity rather than any thing else. One of these is concerning the level of the water of this sea itself, which has been supposed several feet above that of the Mediterranean. "To this (says our author) I answer, that the fact has been supposed to be so by antiquity, and alleged as a reason why Ptolemy's canal was made from the bottom of the Heroopolitic gulph rather than brought due north across the isthmus of Suez; in which last case it was feared it would submerge a great part of Asia Minor. But who has ever attempted to verify this by experiment? or who is capable of settling the difference of levels, amounting, as supposed, to some feet and inches, between two points one hundred and twenty miles distant from each other, over a desert that has no settled surface, but is changing its height every day? Besides, since all seas are in fact but one, what is it that hinders the Indian ocean to flow to its level? What is it that keeps the Indian ocean up? Till this last branch of the

the question is resolved, I shall take it for granted that no such difference of level exists, whatever Ptolemy's engineers might have pretended to him; because, to suppose it fact, is to suppose the violation of one very material law of nature."

The next thing considered by our author is the passage of the Israelites through the Red Sea. At the place where he supposes the passage to have been, the sea is not quite four leagues broad, so that it might easily have been crossed in one night without any miracle. There is about fourteen fathom water in the channel, and nine at the sides, with good anchorage every where; the farthest side is a low sandy coast, and a very easy landing place. "The draught of the bottom of the gulph (says he) given by Dr. Pococke, is very erroneous in every part of it. It was proposed to Mr. Niebuhr, when in Egypt, to inquire upon the spot, whether there were not some ridges of rocks where the water was shallow, so that an army at particular times might pass over? Secondly, whether the Etesian winds, which blow strongly all summer from the north-west, could not blow so violently against the sea, as to keep it back on a heap, so that the Israelites might have passed without a miracle? And a copy of these queries was left for me to join my inquiries likewise. But I must confess, however learned the gentlemen were who proposed these doubts, I did not think they merited any attention to solve them. If the Etesian winds, blowing from the north-west in summer, could heap up the sea as a wall on the right or to the south, of fifty feet high, still the difficulty would remain of building the wall on the left hand or to the north. Besides, water standing in that position for a day, must have lost the nature of a fluid. Whence came that cohesion of particles that hindered that wall to escape at the sides? This is as great a miracle as that of Moses. If the Etesian winds had done this once, they must have repeated it many a time before and since, from the same causes. Yet Diodorus Siculus says, the Troglodytes, the indigenous inhabitants of that very spot, had a tradition from father to son, from their very earliest and remotest ages, that once this division of the sea did happen there; and that, after leaving the bottom some time dry, the sea again came back and covered it with great fury. The words of this author are of the most remarkable kind. We cannot think this heathen is writing in favour of revelation. He knew not Moses, nor says a word about Pharaoh and his host; but records the miracle of the division of the sea in words nearly as strong as those of Moses, from the mouths of unbiassed undesigning pagans."

NATURAL CURIOSITIES IN CARNIOLA.

IN Carniola, which is a duchy of Germany, in the circle of Austria, is the celebrated Lake of Cirknitz, which takes its name from the neighbouring market-town. It is one German mile in length, from north to south, half a one in breadth, and from one to two, three, and four, fathoms, deep; but some of the pits are many fathoms deep. In this lake are three beautiful islands covered with trees: these islands are called Vornec, Velh Goriza, and Mala Goriza. A peninsula also runs into it, and is separated from the island

Island of Vornec by a canal. There are many holes or pits in the lake, with long ditches like canals; and it receives the waters of eight brooks.

It is a common saying, that in this lake a person may sow and reap, hunt and fish, within the space of a year; but this is the least remarkable circumstance in it, and no more than what may be said of almost any other spot that is overflowed in winter or spring. The most wonderful circumstance is its ebbing and flowing. The former always happens in a long drought, when it runs off through eighteen holes at the bottom, which form so many eddies or whirlpools. Baron Valvafor mentions a singular way of fishing in one of these holes, called Ribescajama: he says, that, when the water is entirely run off into its subterraneous reservoirs, the peasants venture with lights into that cavity, which is in a hard rock, three or four fathoms under ground, to a solid bottom; whence the water running through small holes, as through a sieve, the fish are left behind, caught, as it were, in a net provided by nature.

At the first appearance of its ebbing, a bell is rung at Cirknitz, upon which all the peasants in the neighbouring villages prepare, with the utmost diligence, for fishing; for the greatest part of the fish generally go off at the beginning of ebb, and seldom stay till the water is considerably decreased. Above a hundred peasants never fail to exert themselves on this occasion, and both men and women run promiscuously into the lake, stripped quite naked, although both the magistrates and the clergy have used their utmost endeavours to suppress this improper custom, particularly on account of the young lay brothers of a neighbouring convent, who have the privilege of fishing there, and, notwithstanding the prohibitions of the fathers, leave the convent in order to see this uncommon scene. The peasants, however, are not observed to be guilty of more indecency at these times than at others, when they are clothed. At those ebbings, an incredible number of pike, trout, tench, eels, carp, perch, &c. are caught in the lake, and what are not consumed, or disposed of while fresh, are dried by the fire.

Though every part of the lake is left dry, two or three pools excepted, yet, Mr. Keyser says, immediately on the return of the water, it abounds in fish as much as it did before; and the fish that return with the water are of a very large size, particularly pikes weighing fifty or sixty pounds. It is also remarkable, that when it begins to rain hard, three of the cavities spout up water to the height of two or three fathoms; and if the rain continues, and is accompanied with violent thunder, the water bubbles out of all the holes through which it had been absorbed, two of them excepted, and the whole lake is again filled with water in twenty-four, and often in eighteen, hours. Sometimes, not only fish, but live ducks with grass and fish in their stomachs, have emerged out of these cavities. The Abbe Fortis has described a lake possessing the like remarkable quality in Dalmatia.

In a rock on one side of this lake, but considerably higher than its surface, are two caverns, at some distance from each other; and when it thunders, the water gushes out of both, with great noise and impetuosity. If this happens in autumn, they also eject a great many ducks, which are blind, very fat, and of a black colour; and,

though they are, at first, almost bare of feathers, in a fortnight's time, or, at farthest, before the end of October, they are entirely fledged, recover their sight, and fly away. Each of these caverns is six feet high, and as many broad; and, when the water gushes out of them, it is in a large column of the same dimensions, and in a continual stream. There is a passage in each of these caverns, where a man may walk upright a considerable way; but it is said, that no person has ever yet ventured into them, to search into the nature of the inner caves and reservoir to which these apertures lead; for there is no certainty but that, in an instant, he may be surprised by the water rushing upon him, with the force and rapidity of a fire-engine. Something very similar to this is likewise related by the Abbe Fortis, in his account of Dalmatia.

When the lake ebbs early in the year, within twenty days time grass grows upon it, which is mowed down, and the bottom afterwards sowed with millet: but, if the water does not run off early, nothing can be sown; and if it soon returns, as it sometimes does, the seed is lost: otherwise, after the millet harvest, all manner of game is hunted and shot in it.

Adlersberg is a market town of Inner Carniola, situated at the foot of a high rocky mountain, on which stands a citadel. About half way up the acclivity of this mountain, is the entrance into a large cavern, that is divided into a great number of subterraneous passages. The eye is here delighted with viewing a great number of sparry icicles, formed on the arched roof of this vast cavern, by the exudations of a lapideous or petrifying fluid, which form the most beautiful decorations. The sides are covered with all kinds of figures, formed by the same exudations, to which the imagination of the spectator gives various forms never intended by nature; so that it is not at all strange that some people should make out dragons, heads of horses, tigers, and other animals. Several pillars, which are to be seen on each side, proceed from the droppings of the petrifying fluid from the top, which form a kind of sparry pillar on the bottom of the cave: this gradually increases, till, at last, it joins the icicle at the top, by meeting it about half-way, and thus a complete pillar is formed. If a person's curiosity will carry him so far, he may rove about two German miles in the subterraneous passages of this cavern. The present Earl of Bristol (Bishop of Derry) visited a similar cavern in Dalmatia, in company with the Abbe Fortis.

It is remarkable, that the river Poig, which rises in this mountain, about four English miles from Adlersberg, runs again to it with an inverted course, and loses itself near the entrance of the cavern, falling by a great depth into the rock, as is evident from its roaring noise, and the sound caused by flinging a stone into the hole. The same river appears again near Planina; but, soon after, it loses itself a second time in a rock, and at length emerges a third time, when it assumes the name of the Laubach, at the town of that name.

About two German miles from Adlersberg, is another remarkable cavern, called St. Magdalen's Cave. The way to it, being covered with stones and bushes, is extremely troublesome; but the great fatigue in going is compensated by the satisfaction of seeing such an extraordinary cavern. You first descend into a hole, where the earth seems to have fallen in for ten paces before you reach the entrance,

france, which resembles a fissure in a huge rock caused by an earthquake. Here the torches are always lighted to conduct travellers; for the cave is extremely dark. This wonderful cavern seems as if divided into several large halls, and other apartments. The vast number of pillars with which it is ornamented by nature give it a superb appearance, and are extremely beautiful; for they are as white as snow, and have a kind of transparent lustre, not unlike that of white sugar-candy. The bottom is of the same materials, so that a person may imagine he is walking among the ruins of some stately palace, amid noble pillars and columns, partly mutilated and partly entire. From the top sparry icicles are seen every where suspended, in some places resembling wax tapers, which from their radiant whiteness appear extremely beautiful. All the inconvenience here arises from the inequality of the bottom, which may make the spectator stumble, while he is viewing the beauties above and around him.

At Idria, a small town in this part of Carniola, seated in a deep valley, amid high mountains, on the banks of the river Idria, are the celebrated quicksilver mines, discovered in 1497. Before that time, this part of the country was inhabited only by a few coopers and other artificers in wood; but, one evening, a cooper having placed a new tub under a dropping spring, in order to try whether it would hold water, when he came, in the morning, to take the tub away, found it so heavy, that he could hardly move it. At first, the superstitious notions that are apt to possess the minds of the ignorant made him suspect that his tub was bewitched; but, at last, perceiving a shining fluid at the bottom, and not knowing what to make of it, he went to Laubach, where he shewed it to an apothecary, who, being an artful man, dismissed him with a small present, and desired him to bring some more of the same fluid whenever he could meet with it. This the cooper frequently did, being highly pleased with his good luck; but, the affair being at last made public, several persons formed themselves into a society, in order to search further into the quicksilver mine. In their possession it continued, till Charles duke of Austria, perceiving the great importance of such a work, gave them a sum of money, as a compensation for the expences they had incurred, and took it into his own hands.

The subterraneous passages of the mine are so extensive, that it would take up several hours to go through them. The greatest perpendicular depth, including from the entrance of the shaft, is eight hundred and forty feet; but, as they advance horizontally under a high mountain, the depth would be much greater if measured from the surface of the hill. One way of descending the shaft is by a bucket; but, as the entrance is narrow, the bucket is liable to strike against the sides, or to be stopped by something in the way, so that it may easily overset. The other way of going down is safer: this is, descending by a great number of ladders, placed obliquely, in a kind of zig-zag; but, as the ladders are wet and narrow, a person must be very cautious how he steps, to prevent his falling. On descending, there are resting-places, in some parts, that are very welcome to the weary traveller. In some of the subterranean passages the heat is so intense, as to throw a man into a perfect sweat; and formerly, in some of these shafts, the air was extremely confined, so

that several miners have been suffocated by a kind of igneous vapour called the damp; but, by sinking the main shaft deeper, this has been prevented. Near the main is a large wheel, and an hydraulic machine, by which all the water is raised out of the bottom of the mine.

Virgin mercury is that which is prepared by nature, and is found in some of the ores of this mine, in a multitude of little drops of pure quicksilver. This is also to be met with in a kind of clay, and sometimes flows down the passages or fissures of the mine, in a small continued stream, so that a man has frequently gathered, in six hours, above thirty-six pounds of virgin mercury, which bears a higher price than common quicksilver. The rest is extracted from cinnabar (which is the ore of quicksilver) by the force of fire.

Every common miner receives, in wages, three shillings and sixpence a week; but many of them are afflicted with a nervous disorder, accompanied with violent tremblings, sudden convulsive motions of the hands and legs, and frightful distortions of the face. Those are most subject to these disorders who work in the places where the virgin mercury is found, which, in a surprising manner, insinuates itself into their bodies; so that when they go into a warm bath, or are put into a profuse sweat by the steam, drops of pure mercury have been known to issue through the pores, from all parts of the body. These mines are often infested with rats and mice, which feed on the crumbs of bread, &c. dropped by the miners at their meals; but this plague seldom lasts long, for even they are seized with the like convulsive disorder as the men, which soon kills them. It is deemed a necessary precaution for every person to eat, before he descends into these subterraneous regions.

All the adjacent country is very woody; but, that the woods may not be destroyed, great quantities of fuel, for the smelting furnaces, are annually brought down the river Idria, from some forests at the distance of five or six miles. Beside this river, there is a canal two miles in length, supplied with water by several streams issuing from perennial springs, in order to put in motion the machines belonging to the mines.

DR. FOTHERGILL'S PROCESS FOR THE RECOVERY OF DROWNED, STRANGLED, OR SUFFOCATED, PERSONS.

FROM various experiments, the following appearances have been observed to take place in drowning; to which particular attention ought to be paid, as they not only indicate the nature of the death, but the method which ought to be pursued to restore the vital motions.

When an animal is kept under water, it presently begins to expel air forcibly from its lungs in form of bubbles which rise to the surface. This is followed with a strong desire to draw in air, and in this effort it commonly inspires a small portion of water. Air is again emitted, and new efforts made to inspire, and that with similar effects. This is continued with increasing uneasiness from two minutes to five, when respiration ceases, faint gaspings succeed, and it sinks down motionless. Upon taking it out of the water, soon after all its struggles are over, the nose and mouth appear extremely pale,

the eyes do not protrude, the pupils retain in some measure their natural lustre, but are remarkably dilated. All senses and motion, both external and internal, except a feeble contraction of the right side of the heart, are now lost; and, if suitable means of recovery be not made use of, the body gradually becomes cold, and with the loss of heat, the heart by degrees loses its power of contraction.

On opening the chest, the cavities of the right side of the heart, with the corresponding veins, are found to be distended with dark-coloured blood through their whole course. The left side of the heart is often almost empty: also the large arteries, except the trunk of the pulmonary artery where it enters the lungs, which is commonly full of blood. The vessels on the surface of the body appear empty, and the skin as pale as if the animal had been bled to death.

The lungs often appear unaltered, sometimes in a collapsed state; but, if the animal is often suffered to rise to the surface of the water, so that he may inspire air, that organ appears distended. A quantity of frothy fluid, consisting of air and mucus, with a little of the water in which the animal was drowned, may generally be squeezed out of the windpipe. But this is small in proportion to the quantity of air apparently expelled during the act of drowning, though it is more distinguishable when the animal is drowned in ink, or any coloured fluid. The orifice of the windpipe being endowed with exquisite sensibility, the animal, as if conscious of the presence of an improper element, rejects it with a convulsive kind of horror. These efforts to exclude water, and to draw in air, are alternately renewed till strength is exhausted, and respiration ceases. Hence the fruitless struggles, which the animal exerts till it finally expires. After which, no more water probably is admitted; otherwise, after the body has laid some time immersed, we should find the lungs fully distended, which is contrary however to observation. For it often happens, that no water can be discovered in the lungs of drowned animals. From the painful sense of irritation which is felt on a single drop of water, or other liquid, accidentally falling into the windpipe, and from the convulsive motions which ensue till it is expelled, we may form some idea of this distressing situation.

In drowned animals, the heart retains its motion longer than any other part of the body. The motion of its right cavity survives that of the left, and that of the latter holds out longer than the peristaltic motion of the intestines, inasmuch that a weak pulsation of the right chamber of the heart often remains upwards of two hours after respiration has ceased.

On opening the head, the veins sometimes appear rather distended, yet seldom more so than in other violent deaths, but without the least appearance of extravasation.

Upon the whole it appears, that in drowning, the organization of the principal parts remain entire; but that the heart, and large veins in its neighbourhood, are distended with dark-coloured blood, whilst every other part seems in some measure to be drained of that fluid. Nor does the apparent fulness of certain vessels in the brain, the blood-shot eye, the bloated countenance, or the lividity of the skin, so often observed in drowned persons who have remained long under water, especially with their head downwards, prove any thing more than

than that the blood after death had descended by its specific gravity to the more depending parts.

It appears from experiments, that, when an animal is suspended by the neck, it generally ceases to struggle in about five minutes. The external veins of the neck being strongly compressed, the return of the blood from the brain is partially interrupted, but continues to circulate in the internal vessels while the action of the heart remains. The windpipe being shut by the pressure of the cord, and the ingress of air excluded, the eyes become prominent, the countenance grows first red, then livid, and suffocation ensues.

On inspection of the body after death, the blood-vessels of the brain and its membranes seem rather more distended than in the preceding case; the lungs very little altered, and free from frothy fluid; the heart, and trunks of the larger vessels, exhibit exactly the same appearances as in drowned animals.

Animal life is often destroyed by exposure to noxious air arising from fermenting liquors, from quicklime, or metals during calcination, from fumes of charcoal, from close vaults, common sewers, subterraneous caverns, wells of ships, &c.

Mines and coal-pits are frequently infested with two species of noxious air, similar to those above-mentioned. The first termed by miners Choke Damp is native fixed air, generated in the bowels of the earth, which being specifically heavier than atmospheric air, occupies the bottom of the mine. The other called the Fire Damp is a native inflammable air, and, being about ten times lighter than common air, ascends to the upper region of the mine.

These pernicious vapours in their concentrated state, being elements wholly unfit for the purposes of respiration, occasion, the moment they are received into the lungs, an intolerable sense of suffocation, and destroy animal life more speedily than drowning or strangulation. Noxious air in proportion as it is diluted with atmospheric air attacks the principle of irritability, in a more slow insidious way, without producing any violent symptom. When the fire-damp, or inflammable air, bursts out into actual flame, the miners are sometimes dreadfully scorched, though in general, they are not burnt to death, as is commonly supposed, but suffocated by the vapour.

In most of the fatal cases occasioned by foul air, or by lightning, the poor sufferers being generally imagined to be past all hopes, the means of restoration are too often wholly neglected.

Some of those few who have been recovered from suffocation, occasioned by the fumes of charcoal, describe their situation as having been far from painful. That, on the contrary, at first a pleasing kind of drowsiness or delirium stole over their senses, without leaving them even a wish to retire. This was presently succeeded by an entire loss of recollection.

The bodies of animals suffocated in noxious vapours, or killed by a stroke of lightning, exhibit the following appearances. Their limbs remain flexible long after death, except they are killed by nitrous air, in which case, they are said to become sooner rigid than those destroyed by drowning, and that, sometimes, even before the heart ceases to vibrate.

The eyes retain their lustre, and the body a degree of heat often higher than the natural standard. This is particularly observed of those

those that are suffocated by the fumes of charcoal, and their blood, for several hours after death, remains fluid, and even highly florid. In those suffocated by fixed and inflammable air, although the limbs continue pliant, the blood is less florid. In all; the vessels of the brain are found turgid, the lungs little altered, the heart and adjoining vessels equally distended as in those that are drowned on hanged.

Smothering or suffocation may be occasioned by whatever suddenly obstructs respiration.

Thus infants through the negligence of the nurse are sometimes overlaid or smothered, particularly in folding-beds. Still-born children, through the ignorance or inattention of the midwife, are generally pronounced to be dead. Some of them, however, especially such as are upwards of six months old, might by proper means be happily restored to their afflicted parents.

In many instances of this nature, the tongue is drawn back into the throat, so as to shut down the epiglottis, and to close the aperture of the windpipe like a valve, by which the admission of air is prevented. This may be easily remedied by drawing the root of the tongue forward, and by raising the valve with a finger.

Incautious persons, employed in digging sand or gravel, are frequently smothered by the falling in of the superincumbent strata. Others are suffocated in close stoves, or by being shut up in confined air, contaminated by their own respiration, as happened to many of our countrymen in the black cell at Calcutta. Similar accidents sometimes occur in the diving-bell, for want of a supply of fresh air. The same thing happens to animals shut up in the exhausted receiver of an air-pump.

Under all these circumstances, where there is no fatal contusion, the vital functions are suspended merely from want of atmospheric air. The body is often found warmer than natural, the limbs pliant, the lungs nearly natural, the cavities of the heart and large blood-vessels distended with dark-coloured blood. In other respects, the appearances are exactly similar to those occasioned by drowning, or by noxious air.

From what has been observed, it seems evident, that whether death is brought on by submersion, strangulation, or noxious air, the visible effects produced on the vital organs are so nearly similar, that these several modes of suffocation may perhaps all not improperly be referred to one common cause.

The ablest authors, hitherto have been greatly divided in their opinion, not only concerning the nature of vital action, but the cause of its suspension. By some, apparent death is pronounced to be an affection of the lungs; by others, of the heart; while others again contend that it is wholly seated in the head. Some attribute it to a distention of the brain; others to a collapse.—An evident proof that the proximate cause has not yet been fully discovered. Such a striking difference in theory cannot but materially influence practice, and therefore demands investigation.

In cases of drowning, M. Louis, De Haen, and others, consider the introduction of water into the windpipe as the immediate cause of death. But later experiments have shewn, that two ounces of water—a quantity, perhaps, greater than is commonly found in the lungs

lungs of drowned animals, may be injected into the windpipe without proving fatal.

In the hydro-thorax, an incredible quantity of water is sometimes collected in the cavity of the chest, without suddenly destroying life. A remarkable instance of this is related in the *Memoirs of the Parisian Academy of Chirurgery*, where upwards of five pints were repeatedly drawn off by a perforation made between the ribs. As the instrument could be passed to the depth of five inches into the cavity, without touching the lungs, that organ must have been almost deluged with water previous to each operation, and yet the fluid, notwithstanding its pressure, did not produce a sudden suspension of the vital functions.

If an artificial drop of the chest be produced by injecting a considerable quantity of water into the thorax of a healthy animal, it immediately causes oppression, and difficulty of breathing, but no fatal syncope ensues. For the water is gradually absorbed, and the symptoms soon disappear. In drowning, the case is very different, since a few minutes submersion is sufficient to destroy the life of the animal, even whether water enters the windpipe or not; for in many cases none is to be found in the lungs after death. But, if the small portion of water which occasionally enters the lungs (as sometimes actually happens) be still insufficient to cause death directly by suspending respiration, it follows that it must produce it indirectly by excluding the atmospheric air.

Other eminent writers have endeavoured to explain the death of drowned or suffocated animals from a surcharge of blood in the vessels of the brain, and have therefore considered it as a case of real apoplexy. Among these may be mentioned M. Littre, Wepfer, Boerhaave, and Cullen, to whom also may be added the ingenious Mr. Kite, who, (in his late elaborate essay) appears to have investigated the subject with no small attention. An opinion advanced by such able writers, and so powerfully supported by their followers, ought not to pass unnoticed.

The distention of the blood-vessels of the brain observable in these cases, and particularly after strangulation, (though much insisted upon,) affords no convincing proof of apoplexy, since a variety of other instances of violent death present similar appearances, even where there could be no suspicion of the brain being overcharged.

In almost every fatal accident proceeding from an external cause, the blood preserves its fluidity much longer than where sudden death is occasioned by any internal affection; and the elastic force of the arteries continues several hours after death to propel the uncoagulated blood onwards towards the veins. Hence blood often flows afresh from the orifice of a vein long after life is extinct. Hence also the apparent distention of the veins, without any real increase of the quantity of blood. Nor is it even pretended that in violent death, produced by drowning or suffocation, any extravasation of blood, or serum, has ever yet been discovered in the cavities of the brain, though generally very conspicuous in fatal incidents occasioned by genuine apoplexy.

Mr. Kite, one of the most powerful advocates on the side of apoplexy, having endeavoured to prove, that in cases of hanging, death is not occasioned by the compression of the nerves of the neck, or of the carotid arteries, adds the following remarkable passage,

passage, which unfortunately strikes at the very foundation of that system of plethora which hitherto he had so strenuously supported.

"A third opinion is, that death proceeds from the compression of the jugular veins: but it appears from the experiments of M. Emmettus that all the larger veins of the neck, both internal and external have been separately tied, without apoplexy or even sleepiness having been induced. Further it is related, that, the carotid arteries and jugular veins being all tied in a dog, he yet enjoyed the most perfect health and vivacity for some weeks! The same author further observes, that upon repeating the operation often, although none of the dogs died, or were apoplectic, yet some of them, for the space of a few hours, seemed sleepy."

Certainly a more likely method of producing a sudden and violent surcharge of blood in the brain could hardly have been devised by human ingenuity, and yet we are told, so far from causing apoplexy, it "only occasioned drowsiness for a few hours, and that in all other respects the animals enjoyed the most perfect health and vivacity."

The experiments, moreover, having been often repeated, and similar ones also instituted by Mr. Kite and others with the same effect, we can scarcely entertain a doubt respecting their validity. •

Now, admitting these facts, the conclusion is obvious, viz. that, in cases even of hanging, death is not occasioned by a congestion of blood in the brain.

Neither, on the other hand, does diminishing the quantity of blood conveyed to the brain retard the fatal event, as may be seen from the following experiments:

"The windpipe of a dog," says an acute experimentalist, "was secured by a ligature at the instant of inspiration; in less than four minutes he ceased to struggle. The blood in the left side of the heart compared to that of the right was as thirteen to twelve. The veins of the head were evidently less distended than natural. Here then, there being no obstruction to the passage of the blood through the lungs, it could not be collected in the right side of the heart, and consequently no accumulation was found in the head, and yet this animal died as soon as others, from ordinary hanging."

Again—"The two carotids of a dog were secured (which we now know may be done without materially injuring the functions of the animal). In half an hour after this operation, he was hanged. In less than four minutes he ceased to move. The vessels of the brain were much less distended than in ordinary death. Here the principal supply being cut off, instead of the vessels of the brain being a state of congestion, they contained a much less quantity than natural, and consequently no species of apoplexy could follow from distention, and yet this animal died as soon as others which had undergone no such operation."

The following experiment, by that eminent anatomist Professor Monro, evidently proves that, in hanging, death is not produced by apoplexy, but a very different cause:

"A dog was suspended by the neck with a cord; an opening having been previously made in the windpipe below the cord, so as to admit air into the lungs. In this state, he was allowed to hang three quarters of an hour, during which time, the circulation and breathing went on without being much interrupted by the experiment. The cord being now shifted below the opening into the wind-

pipe, so as to intercept the ingress of air into the lungs, and the animal being again suspended, was completely dead in a few minutes." Than which nothing can be more decisive, at least so far as one solitary experiment can extend.

It is moreover observable that in apoplexy life often continues several hours, while in drowning or hanging the animal functions are abolished in a few minutes. In apoplexy, respiration, together with the action of the heart and arteries, go on, and the pulse often vibrates more forcibly than in health. In hanging, or drowning, respiration is suppressed, and the pulse obliterated.

In apparent death from apoplexy, very few recover, and those few generally become paralytic.

In vital suspension from drowning or hanging, many are restored, and yet no palsy supervenes.

In the former, copious bleeding affords the principal relief; in the latter, it generally proves highly injurious.

In a word, the two cases evidently appear to be totally different, and to require a very different mode of treatment.

In cases of apparent death, an apoplexy indeed may sometimes occur, not as a certain consequence but as an accidental circumstance. Thus in hanging, if the feet are pulled violently to accelerate death, as often happens, it may produce a dislocation of the vertebræ of the neck, and extravasation in the brain. Or in drowning, if the person happens to be in a deep state of intoxication, or receives a contusion of the head in falling into the water, and yet after all is restored to life, it is no wonder if an apoplexy or palsy ensues—a circumstance, however, by no means frequent in other cases of restoration from apparent death.

Others imagine they have traced the immediate cause of death to the presence of black blood in the left side of the heart and its vicinity. This blood, being deprived of the influence of the air, is supposed to be now rendered incapable of exciting the action of the heart, and therefore must be the proximate cause of the suspension of its functions.

This opinion, though sufficiently plausible like the former, may possibly, on further inquiry, be found equally void of foundation. For, in the first place, this dark-coloured blood is by no means peculiar to cases of drowning or suffocation, being on the contrary almost an inseparable attendant on sudden death, from whatever cause produced.

Secondly. Even admitting it to be the immediate cause of death, in the cases now under discussion, it follows that, if by any means we could restore this black blood to its florid colour, we might with certainty restore life; for, the cause being removed, the effect must cease. Now this change of colour may be readily accomplished in the pulmonary blood by merely inflating the lungs with common air. And, were this alone sufficient to recal life, would it not be unpardonable to suffer any one to die suddenly of this dark-coloured blood, where a bent tube and a pair of bellows could be procured? But experience shews that inflating the lungs of an animal apparently dead, though it changes the contiguous blood to a florid state, yet, unless it also succeeds in restoring the natural action of the heart and lungs, it avails nothing towards the restoration of life.

Thirdly.

Thirdly. It further appears from experiments on drowned animals, that the heart, instead of instantly stopping, continues to contract a considerable time after the blood has acquired this dark colour. In fishes, and in the human embryo, the blood must necessarily appear dark, and yet the circulation is performed with sufficient vigour.

Fourthly. In suspended respiration, the dark-coloured blood is not confined to the cavities of the heart and pulmonary vessels, but extends through the circumvolutions of the brain, and whole sanguiferous system. Therefore, if the action of the heart could not be excited until the entire mass of blood were changed to its pristine colour, no person apparently dead could ever be restored. For, were black blood the efficient cause of the suspension of the action of the heart, that organ would for ever remain at rest, till the necessary change of colour could be brought about.

Fifthly. It has been observed by an eminent author, that, on exposing an animal to intense heat, the blood when drawn from a vein appeared as florid as that which issued from an artery. That, on the contrary, when subjected to extreme cold, the blood assumed as dark a colour as if the animal had been drowned; and yet these remarkable changes in the appearance of the blood caused no visible change in the animal functions.

Can we suppose, then, that dark-coloured blood supports life in one case, and destroys it in another?

In the cold fit of a quartan ague, the lips and whole visage suddenly assume a livid hue. In the subsequent hot fit, the countenance becomes intensely red. But notwithstanding the blood suddenly becomes dark-coloured, during the severity of the rigor, yet the vital actions are not suspended; on the contrary, the pulse and respiration are manifestly accelerated, and, though the patient shivers with extreme cold, the thermometer placed under the arm-pit shews no real diminution of natural heat.—A circumstance, which I have more than once observed, but not without astonishment!

Sixthly. During suspended respiration, the black blood in the left cavity of the heart and arterial system cannot resume its florid colour, till it has completed its circuit, and returned through the lungs. Hence it is evident, the heart must be brought to contract from the stimulus of this black blood, before the circulation can be restored.

On the whole then, since the presence of black blood has been found to be neither incompatible with life, nor to preclude recovery; it cannot be admitted as the efficient cause of the suspension of the circulation, much less as the immediate cause of death; but the effect, or rather a concomitant circumstance.

“The proximate cause of that disease produced by drowning, hanging, and suffocation,” says another late writer, “appears to be mechanical obstruction in the interior pulmonary vessels, from collapse of the lungs, with a want of latent heat in the blood.”

This idea seems to approximate more nearly to the truth, but, still leaving a small space between, resembles those parallel mathematical lines, which are said to be continually approaching each other, and yet never meet. For his own experiment, so well imagined for guarding against accumulation in the brain, must have still more directly prevented collapse, or mechanical obstruction in the interior pulmonary

pulmonary vessels. Therefore though meant to subvert the hypothesis of another, it unluckily tends to sap the foundation of his own.

Accordingly it informs us, "there being no obstruction to the passage of the blood through the lungs, it could not be collected in the right side of the heart, and yet this animal died as soon as other animals from ordinary hanging."

Besides, were this the real cause of apparent death, it is not easy to conceive how restoration could ever be brought about without inflating the lungs; and yet instances of spontaneous recoveries are by no means wanting.

In certain cases, moreover, the heat of the body, even after death, has been found to exceed that of health, and therefore neither a want of latent or sensible heat in the blood could be supposed to constitute any part of the disease. Thus a violent flash of lightning, the fumes of charcoal or of burning sulphur, cause immediate death or suffocation, without extinguishing animal heat, which rather increases, and continues several hours.

The lungs, after the last expiration, contain a quantity of air, and, instead of suffering a collapse, are often found considerably distended after death. The same is observed in animals that die under the exhausted receiver of an air-pump, which probably happens in the act of inspiration. Be this as it may, a collapsed state of the lungs, upon which such stress has been laid, should it ever occur, cannot be the immediate cause of death, but rather the effect of a certain mode of dying.

Others imagine the question admits of a very simple and easy solution, and therefore without hesitation pronounce the proximate cause of death (in the cases under consideration) to be nothing more than a mere stoppage of respiration. But they seem to forget that the effect ought immediately to follow the cause, as the shadow does the substance. Were their position true, persons in a state of syncope or apparent death would be utterly irrecoverable, and torpid animals could never be roused into action. Not to mention that in the pearl fisheries expert divers are known to remain twelve or fourteen minutes under water without breathing.

It appears from what has been observed, that the effects of the various kinds of suffocation are so very similar, that they may be considered as dependent on the same cause, viz. the privation of vital air. This animating fluid, derived from the atmosphere, being essential to respiration, and respiration to life, leads us to trace the following chain of causes and effects, which in the act of drowning or suffocation of necessity follow each other in rapid succession.

No sooner is the vital air excluded, than respiration is suspended; respiration being suspended, the passage of the blood through the lungs is intercepted, and of course through the whole system. The action of the heart being impeded by the same cause, the circulation is suppressed. The brain, unsupported by the circulation, being unable to exert its influence, the mental and corporeal actions cease, and the mind is no longer conscious of the state of the body. The blood being deprived of its power of generating heat, a coldness diffuses itself over the system. Unless aid be now properly administered, the principle of irritability gradually forsakes the fibres, first in the extreme parts, afterwards in the heart itself, when the animal dies.

From an attentive consideration of the various phenomena thus brought into a small compass, the order in which they succeed one another, and the effects which ensue; does it not appear evident that, in these different species of suffocation, the exclusion of vital air from the lungs is the primary cause of suspended respiration, and that suspended respiration is the immediate cause of the suspension of the other vital actions? But, since vital action may be suspended by various causes without being extinguished, it is now well known that persons, labouring under such a state of suspension, may often yet be recovered by renewing the action. Such a critical situation, however, may not improperly be considered as an intermediate step between life and death. If to this succeeds the extinction of irritability, or of that oscillatory principle (whatever it may be) which renders the heart and muscular fibres susceptible of stimulus, it constitutes the proximate cause of death.

This law of nature, which extends to every living creature, is immutably fixed by the Creator, otherwise man might presumptuously arrogate to himself the power of raising the dead, and dispensing even immortality.

It were therefore to be wished, that the terms re-animation, re-suscitation, re-vivification, &c. which are now become so familiar, but which to superficial readers may seem strongly to imply the act of resurrection, were either laid aside, or explained under due restriction. To restore a person from a temporary suspension of vital action, is within the province of the physician:—But to restore life, after it has entirely vanished, is an act of Omnipotence, and belongs only to Him who gave it. The former is merely to re-kindle the flame of a taper, by gently fanning the ignited wick: the latter, to re-animate a corpse, after the vital spark is totally extinct.

As absolute death consists in a total cessation of all the vital and animal functions, with an entire loss of irritability; so apparent death, in the various kinds of suffocation commonly termed asphyxia, may be defined a temporary suspension of the vital motions, in consequence of the privation of vital air essentially necessary to respiration.

If this idea of the nature of the disease be just, it will enable us to unfold the principal symptoms, and to point out the most rational method of cure.

In every case of vital suspension, the primary object is to institute artificial respiration, till the natural breathing can be re-established. The propriety of this being generally allowed, various methods have been invented to accomplish it, though by different means. Those, who attribute the efficacy of this process to the mere mechanical expansion of the lungs, regard not the quality of the air; nay, some even contend, that air blown from the lungs of a healthy person is better adapted to the weak state of the vital powers than any other sort. Others deny that air, already vitiated by respiration can be fit for the purpose (to say nothing of the apparent indelicacy of the operation), and therefore justly prefer atmospheric air.

Having formerly recommended vital air in preference to the other two, not only from theory, but actual experiment on some of the smaller animals, its superiority has since been confirmed by many respectable writers both at home and abroad.

Nor

Nor is this to be wondered at, seeing it possesses every necessary quality of common air, in a supereminent degree, and is alone capable of producing that chemical change in the blood upon which vital heat and irritability depend. For during the suspension of respiration, agreeable to what has been hinted, the blood loses its florid colour, from being deprived of the vital part of the atmosphere. The animal heat also is suddenly diminished, and the action of the heart grows weaker every moment, till at length it ceases.

That curious aquatic creature, the rotillus or wheel insect, is perhaps, of all others, the most tenacious of irritability. Long after it has appeared to be dead, and even shrivelled, it may still be restored to life, by only dipping it in water, and exposing it, while moist, to the rays of the sun. The reason of which seems to be this: the sun decomposes the water, and the vital air, being evolved, gradually renews the latent principle of irritability; because, unless the insect be previously moistened with water, it cannot be revived.

The feeble state of life then, instead of being an objection to the use of vital air, is rather a proof of its being indispensably necessary.

In the act of drowning, though suffocation generally takes place after a full expiration, yet it has been computed, that from fifty to one hundred cubic inches of air still remain in the cells of the wind-pipe. Though this stagnant air must be highly vitiated, and therefore injurious to life, yet it cannot be evacuated by pressure, much less meliorated by similar air conveyed from another person's lungs; but may, nevertheless, be corrected by atmospheric air, and completely restored by vital air.

The ingenious Abbe Fontana, in attempting to respire pure inflammable air obtained from iron, had nearly fallen a victim to his curiosity. On the second inspiration, his countenance was observed to become suddenly pale.—On the third, he fell down motionless. Being now removed by the assistants into the open air, he at length happily recovered.

Carbonic and azotic airs, when pure, are still more suddenly fatal than the inflammable; yet may either of these be respired several minutes without much danger, when diluted with little more than an equal part of atmospheric, or even one fourth of vital, air.

On the whole, it seems reasonable to conclude, that, in the treatment of persons suffocated by the various kinds of noxious air, respired air must be less proper than atmospheric, atmospheric than vital; and that, could the latter be as easily and cheaply procured as the two former, few persons could hesitate a moment in determining which of them they ought to prefer. Whence is it then, that the use of vital air has hitherto been withheld from the human species, and confined to a few experiments on brute animals? Because it is even yet but little known; and its virtues still less understood.—A remedy rarely to be had when most wanted, and never without some trouble and expence.

It might, however, be procured on moderate terms from common nitre, which yields it in very considerable quantity—an article, unless in time of war, generally to be obtained remarkably cheap. How many thousand tons of nitre has Europe consumed of late, in making gun-powder, and that with the avowed intention of destroying thousands of its inhabitants? Might not a small portion be spared for

for another purpose, at least equally humane and laudable; viz. that of preserving a remnant of our unfortunate fellow-creatures!

Is it not singularly curious, that a substance of such very humble pretensions as common nitre (or salt-petre) should possess properties on which hangs the fate of the most powerful empires! since by chemistry, it may either be converted into a fulminating engine, to overturn fortified cities, or to enable the garrison to launch out death and destruction on the besiegers! or that, by a different process, it may be made to pour forth vital air—that vivifying fluid diffused through the atmosphere, which breathes in the zephyrs, which whispers in the breeze, and which cheers and supports all animated nature!

It has been computed by the Abbe Fontana, that a pound of nitre, calcined in close vessel, yields about twelve thousand cubic inches of vital air—a quantity sufficient for a person to breathe more than twenty-four hours. As this air does not unite with water, it might be kept in large glass jars inverted in a proper tub of water, like any other air used in philosophical experiments; or, were it made to rest on a surface of lime-water, it would be equally secured, and its purity might be preserved for a great length of time. This might prove an important addition to the apparatus of our Humane Society's receiving houses, where it might be kept in readiness against emergencies, and managed with equal facility as common air. There also might its comparative merit be determined by decisive experiments.

The operation of inflating the lungs with this vital air, completely, demands considerable address; and, as it constitutes the most important part of the process, it were to be wished, that not only medical pupils of all denominations, but also some other intelligent persons, in every parish, were fully instructed how to perform it with dexterity.—A circumstance of no small consequence, especially in country-places remote from medical aid. The operation may be tolerably performed, by the common people, by only inserting the pipe of a pair of bellows, drawn full of vital air, into one nostril, while the mouth and opposite nostril are closed by an assistant, and the windpipe gently pressed back;—Then by forcing the air into the lungs, and alternately expelling it by pressing the chest, respiration may be imitated. In want of bellows, the air may be blown through a tobacco-pipe, a quill, a pencil-case, or even a card folded into the form of a tube.

As soon as the lungs are fully expanded with air (and the more pure this is, undoubtedly the better), at that moment, let the heart be excited by a gentle electrical shock, passed obliquely from the right side of the chest through the left, in the direct course of the heart and pulmonary vessels. Let the lungs be now emptied of the air, and again expanded, when another shock may be given. The heart being thus excited into action, the dark blood, loitering near its right cavity, will begin to move forward, and to resume a more florid colour. This being gradually renovated, will renew the action of the left ventricle, when the circulation will also be speedily restored, and that perhaps with more certainty and expedition than by the usual mode of conducting the operation.

The longer respiration has been suspended, and the more the vital powers are enfeebled, the more gentle ought to be the means of restoration.

restoration. In which case, it may be prudent to begin with moderate vibrations, or very slight shocks; and, instead of repeating them at every inspiration, to postpone to every second or third successive expansion of the lungs. For it will be safer to keep pace with the slow and languid movements of the heart, than to waste the small remains of irritability in fruitless exertions.

From the effects of vital air, in supporting respiration; in giving a florid colour to the blood; and in generating heat; we learn why in suspended respiration the lungs cease to expand, the heart to contract, the arteries to vibrate, and finally why the machine, though sound and entire in all its parts, yet, on a sudden, like a clock whose pendulum is stopped, remains entirely at rest. In the latter, if we move but the pendulum, the wheels are immediately put in motion, and the clock again correctly marks its hours and minutes as before: so likewise in the animal machine, (for such is the harmonious consent of parts,) if motion can but be renewed in one of the principal organs, it is directly communicated to the next, and from thence to all the rest.

Thus, if the lungs respire, the heart recovers its action, the brain its energy, the nerves their sensibility: the grand obstacle once removed, the subordinate springs of life presently resume their respective movements.

From the privation of vital air in drowning, we can now explain why the blood grows dark, the lips and countenance livid, and why the body loses its native heat; since, by renewing respiration, circulation is renewed, and the blood, having regained what it had lately lost, all these symptoms soon disappear, and health and life are happily restored.

THE INSTRUCTIVE NATURALIST, No. V.

OF INTEGUMENTATION, AND IRRITABILITY.

ALL living bodies are furnished with one, two, or with more, integuments, which are prepared by secretory organs, and which are a defence against those injuries to which their situation is commonly exposed. Of the integuments, some prevent the dissipation of the fluids, some again resist acrid and corrosive substances, some are indigestible in the stomach, and some are seemingly incorruptible in the earth. By these properties they preserve seeds and the ova of insects for a number of years, waiting the change of soil or of season. They protect both from the action of weak membranous stomachs, and make those animals who choose to swallow them contribute likewise to their propagation. The gelatinous substance ejected by birds, and called the tremella-nostoc or starfall, we have lately found, by numerous experiments, to be a substance of this kind. It is nothing else than the oviducts of frogs, which, as the embryo in form of an egg moves along their winding canal, are intended by nature to secrete that transparent and viscid glaire which constitutes the albuminous part of the ovum, and feeds and protects the embryo in water.

Some integuments are chiefly useful by their strength and hardness. The shells of the beetle are an excellent defence for the membranous wings which the creature is seen to pack up in folds when

when it inclines to creep into the earth. The shell of the snail lodges the intestines when the animal comes forth to search for its food, and it furnishes a safe retreat for the body when any danger is threatened from without. Some animals, confined to their shells, can open and close them by a muscular power; and some shells, like the scales observed on fishes and insects, are disposed into plates, so as to be no hindrance to motion. Several insects which spend a part of their time in the water always compose a shell for themselves where it is needful. The usual materials are sand, straws, or mud, which they cement by a viscid secretion. The shells of most insects are corneous. Swammerdam found that cretaceous shells are composed of layers of indurated membranes, and, that they are sometimes covered with a cuticle.

Some integuments are covered with feathers, some with hair or a thick down. Besides many other obvious uses of these coverings, they serve in general to repel insects; and, being bad conductors of heat, maintain a genial and necessary warmth.

When the integuments are covered with prickles, they repel attacks by the strength of their points, or by the venom which they infuse, as the stings of nettles and the downs of some insects and plants.

When they are moistened with a viscid secretion, they preserve the necessary softness of the parts, prevent evaporation, resist acrimony, enable plants to destroy their enemies, and assist the snail in performing its motions.

Both plants and animals, but particularly the former, are often protected by an odorous effluvia from their integuments. This effluvia is the finer part of their volatile oil, always inflammable, and so subtle, that the continual emission of it from wood or flowers does not sensibly diminish their weight. To this fragrance it is owing, that the deadly nightshade, the henbane, hound's tongue, and many others, are seen on almost every high road untouched by animals. The mancinelle-tree of the West Indies emits so very dangerous vapours, that the natives poison their arrows with its juices, and those have died who have ventured to sleep under its shade. The lobelia longiflora of America produces a suffocating oppression in the breast of those who respire in its vicinity. The return of a periodical disorder has been attributed to the exhalation of the rhus toxicodendron. Every one knows, says Chaptal, the effects of musk and oriental saffron on certain persons. Ingenhoufz mentions a young lady whose death was occasioned by the smell of lilies; and Triller reports an instance of another who died in consequence of the smell of violets. The selection of grasses by different animals seems to be owing to the manner in which the volatile anoma affects their senses. But of all the vegetable exhalations known, those emitted by the bohun-upas, or poison-tree of Java, are the most remarkable. For many miles round no animal can breathe the air, no plant dares to peep from the soil, the fishes die in the poisoned stream, and the birds that venture athwart the atmosphere with despairing shrieks sink down lifeless. Such often is the use of the fragrant oils in the vegetable economy. The shrubs and trees that are covered with thorns are in general a grateful food to animals. They generously avow their manner of attack, and scorn the dark assassination by poisons.

The various colours of the integuments, as well as the aroma, is a species of defence. "Caterpillars which feed on leaves (says Darwin) are generally green; and earth-worms the colour of the earth which they inhabit. Butterflies which frequent flowers are coloured like them. Small birds which frequent hedges have greenish backs like the leaves, and light-coloured bellies like the sky, and are hence less visible to the hawk who passes under them or over them. Those birds which are much amongst flowers, as the goldfinch, are furnished with vivid colours. The lark, partridge, hare, are the colour of dry vegetables or earth on which they rest; and frogs vary their colour with the mud of the streams which they frequent, and those which live on trees are green. Fish which are generally suspended in the water, and swallows which are generally suspended in the air, have their back the colour of the distant ground, and their bellies of the sky." The sphinx-convolvuli, or unicorn-moth, resembles in colour the flower on which it rests; and among plants, the nectary and petals of the ophrys, and of some kinds of the delphinium, resemble both in form and colour the insects which plunder them, and thus sometimes escape from their enemies by having the appearance of being pre-occupied. From colour being thus employed as a defence, many animals vary their colours with the seasons and circumstances; and those which are of different colours in summer, according to the place which they inhabit, do all in winter assume in common the colour of the snow.

But a change of colour is not the only change of the integuments. As the outmost are often insensible to stimulants, and for obvious reasons possess little of the vital principle, in all cases where they cannot be enlarged to admit an additional increase of growth, or where they are not furnished with necessary organs to repair those injuries which they may suffer from disease or accident, the body is endowed by nature with a power to throw them off, and to produce others in their stead. For this reason we see the tree casting annually its exterior bark, the lobster his shell, the bird his feathers, the quadruped his hair, and sometimes his horns, the serpent his skin, and man himself renewing the scales of the epidermis. These changes usually take place once a-year, twice frequently with respect to serpents, and oftener in toads, who have been observed to devour the skin which they throw off. All the integuments of ova and seeds, being wholly the production of parental organs, neither are nor can be repaired.

IRRITABILITY is that property of the living fibre by which it acts in consequence of stimulants. Being one of the great causes of motion in living bodies, no property has excited more wonder, been the cause of more error, or exhibits such a number of striking phenomena to the senses. These effects, however, have arisen rather from the nature of the stimulants than from any thing mysterious in irritability. Many of the stimulants by which this property in bodies is displayed are often invisible, unknown, or unthought of; and men being conscious that a number of their motions proceed from a stimulant, that is, under the direction of a mental power, they readily conclude from a sort of analogy, that every motion in plant and insect that seems to answer a useful purpose, and is caused by some invisible stimulant, is the consequence of mind directing from within. They further suppose that irritability is in all cases the
consequence

consequence of nerves, which are those organs which nature has employed in the animal kingdom to convey stimuli between body and mind. These singular conclusions have led to others that are less admissible even than themselves. It has been imagined that creatures the most stupid possess within them a principle of mind that is incapable of further improvement, but which notwithstanding is in many respects superior to reason, and a surer guide in whatever relates to self-preservation or that of the species: it enables the animal to predict without foresight, and to act rationally without intelligence. This wondrous principle has been called instinct: and, in order to account for some of the singular phenomena of vegetables, a share of it has graciously been allowed to plants; which, having become favourites of late, have been also presented with the privilege of sensation, permitted to fall in love, and to marry, and on some occasions to exercise the faculty of volition.

At these concessions the metaphysician will naturally smile. He knows how many impose on themselves by the mere sound of their own words, as if by calling the snow black they were to discover a new property; which curious discovery would turn out at last to be only a gross ignorance of language, and the foolish misapplication of a syllable. He who has studied the philosophy of mind, and been accustomed to view objects through another medium than the magic colourings of passion and of fancy, readily perceives a something of absurdity in ascribing such wisdom to plants and insects. With respect to animals, these gentlemen do not recollect that voluntary actions are of two kinds, as they proceed from design or propensity; that in performing one of these kinds the mind itself has an object in view, and is properly the source whence they originate; but that in the other the mind is merely a secondary agent, is acting under the influence of stimulants, is often not aware of the consequences, or although aware is often so infatuated as not to regard them, however fatal. It is generally well known to the naturalist, that not a few of these propensities arise from the form and structure of the body, from the manner in which the optic nerve is affected by colours, the olfactory by smells, the gustatory by tastes, and the auditory by sounds; from the different ways in which the fauces are affected by thirst, the stomach by hunger, and the genital parts by venereal orgasmus.

Besides these and other propensities which operate as stimulants in the system itself, the naturalist has found that light, heat, and moisture, in various degrees, from absolute darkness, coldness, and dryness, act as stimulants upon living bodies: he has experienced that electricity is a general agent, that several plants emit flashes, and that some animals even give shock resembling the electric. "In Sweden (says the author of the Loves of the Plants) a very curious phenomenon has been observed on certain flowers by M. Haggeren, lecturer on natural philosophy. One evening he perceived a faint flash of light dart from a marigold: surprised at such an uncommon appearance, he resolved to examine it with attention; and, to be assured that it was no deception of the eye, he placed a man near him with orders to make a signal at the moment when he observed the light. They both saw it constantly at the same moment; the light was most brilliant on marigolds of an orange or flame colour, but scarcely visible on pale ones; the flash was frequently

seen on the same flower two or three times in quick succession, but more commonly at intervals of several minutes; and, when several flowers in the same place emitted their light together, it could be observed at a considerable distance. This phenomenon was remarked in the months of July and August at sun-set, and for half an hour after when the atmosphere was clear, but after a rainy day or when the atmosphere was loaded with vapours nothing of it was seen. The following flowers emitted flashes more or less vivid in this order:—The marigold, garden nasturtion, orange-lily, African marigold; sometimes it was also observed on the sun-flowers; but bright yellow, or flame colour, seemed in general necessary for the production of this light, for it was never seen on the flowers of any other colour. The flowers were carefully examined with a microscope without any insects or phosphoric worms being found. M. Haggeren, after having observed the flash from the orange-lily, the anthers of which are a considerable space distant from the petals, found that the light proceeded from the petals only; whence he concludes, that this electric light is caused by the pollen which, in flying off, is scattered upon the petals. It is even probable that electricity produces all the wonders of crystallization; and that the cause of chemical affinity, and of all the phenomena displayed by the magnet, if not simply a modification, is at least akin to it. In the male parts of plant and animal, the curious naturalist has seen both the fluid and the pollen that give the stimulus in generation, and are accompanied with so extraordinary changes in the system. He has found that much of the vegetable economy, and that even the function of generation itself, as the developement of the fecundating powder, and its application to the female organ, is partly carried on by wind, heat, and other such agents. He has reason to conjecture that many general agents in nature are yet unknown. By the help of chemistry, he has found out lately a considerable number which are called gases, which are of the very highest importance in both the animal and vegetable economy, and which, like the aromas of plants, or the causes of contagion, produce their effects without being visible. It is only, too, of a late date that the celebrated Professor Galvani of Bologna has excited so much curiosity through Europe, by the discovery of a certain stimulus that resides in the nerves, that passes along electric conductors, and which by a certain application of metals occasions a vivid flash in the eye, convulses the body of a living frog, and rouses the detached limbs into action. The change of colour in the integuments according to different seasons and circumstances, though it answer a rational and useful purpose, proceeds from a cause that does not seem to be very well known. Even many agents which are not invisible, nor yet unknown, exert their influence in a secret manner, so as not to be obvious to the senses. It is generally known that many singular movements of plants are owing to heat, many to light, and several to moisture. The barley-corn is often observed to creep on the ground by means of its awn, which dilates and contracts according to the different degrees of moisture. The wild oat, employed as an hygrometer, moves through the barn, travels through the fields, nor ceases to be changing its situation till its beard falls off, or till it meets with a soil where it conveniently may strike root. Upon a similar principle of motion, the ingenious Edgeworth constructed

fructed an automaton which moved through a room which it inhabited. It is easily conceived how these singular effects, arising from causes that are unknown, invisible, or unthought of, should give birth to the notions of witchcraft and of instinct, and impress the fancy with an idea of something resembling sensation and volition in the vegetable kingdom. These agents, whether invisible, unknown, or unthought of, directed by regular and uniform laws under the great Author of nature, produce effects that indicate prescience, wisdom, and design, and causing a transient or permanent propensity in the mental part, frequently controul by resistless sway the finite minds that reside in matter. These minds, in a living body, have generally been found accompanied with some system of nerves; and these nerves happening with equal facility and promptness to convey stimuli from the mind to the body and the body to the mind, the great difficulty has been to determine with respect to others when the action proceeds solely from design, solely from propensity, or from design and propensity together. The uniform conduct of the brute creation would seem to imply that their mind has little of inventive power; that it generally acts from the impulse of propensity; and that its manners are varied, not in consequence of a change of sentiments, but from the induction of new habits, and the application of new stimulants.

It has been observed, that in all animals the vigour of mind has some relation to the quantity of brain, and to the perfection of its organization; and that the acuteness of the different senses is generally proportioned to the quantity of nerve bestowed on their organs. The acuteness of the senses depends upon the readiness with which their organs are affected by stimuli. This readiness depends on irritability. It is not necessarily connected with mind, nor should it ever be confounded with perception, which in classical language signifies a property of the mental principle. Man has a greater proportion of brain than any other animal; but many an animal has a much greater proportion of nerve bestowed on different organs of sense. Many animals have therefore acuter senses than man; but man has a greater vigour of mind than any other animal on this globe.

The brain of quadrupeds is somewhat similar to that of man, but proportionally smaller, and not perhaps so well organized. Willis has observed, that among animals the structure of the cerebrum is more variable than that of the cerebellum; that the former generally furnishes nerves to the voluntary muscles, and the latter with the medulla oblongata to the involuntary. He has likewise remarked, that the round prominences commonly called the nates and testes are large in the quadrupeds which are active and vigorous, and in some measure able to procure their own subsistence at birth; that the tuber annulare is large in the quadrupeds that are distinguished for their sagacity; that wherever the tuber annulare is small, the prominences are large, and wherever it is large the prominences are small. From these observations he has concluded that the tuber annulare is the seat of genius, and the round prominences the seat of what has been called instinct.

The brain of birds is seemingly the reverse of the human brain; the cortical substance is the interior, and the ventricles are situated in the white part on the outside. In the brain of the bird there are

no circumvolutions like the intestines, no fœmex, corpus callosum, nor corpora striata.

The brain of fishes is in many respects similar in its structure to the brain of birds. It is very small in proportion to their body, and is generally surrounded with an oily matter. In one genus of fishes, the gadus, Mr. Monro found spheroidal bodies between the dura and pia mater, and covering the greater part of the nerves like a coat of mail. The two senses, seeing and hearing, in many fishes are often acute. By laying one ear on the water, and striking the surface at some distance, this element is found to be a better conductor of sound than even the air.

The reptile tribes have very little brain, and like the fishes have no ganglions upon their nerves.

Most insects have no brain at all, but a nervous cord that is full of ganglions, that runs from one extremity to the other, and is denominated the spinal marrow. This knotty cord, however, is not marrow; the insect has nothing resembling a spine; and the situation of the cord in the animal is often not along the back, but the breast. In the silk-worm, and most other insects, this cord is in contact with the alimentary canal; and the first ganglion, which is sometimes called the brain, though not in the head, divides, in order to give a passage to the stomach, and again unites in a second ganglion. Swammerdam found in a species of snail a brain with two lobes, in contact with the stomach, moveable by muscles, and without a fixed place in the body.

The polypes exhibit no appearance of brain or of nerve, as in other animals. Their skin, however, is observed to be full of a number of small granular bodies, which are connected by a glaucous matter that resembles a thread. Like rows of bead-strings, they extend from one extremity to the other, and along the arms. Trembley learned from a number of experiments that they received their colour from the food, and therefore supposed them to be vesicles or glands. If not like the tuberculous nerves of the insects, they at least are not very different in appearance from the nerves of the gadus, that are covered with a number of spheroidal bodies like a coat of mail.

Some things would insinuate that a nervous system does not seem to be necessarily connected with mind. The stimuli of nerves may be brought into action by other causes besides mind. Even many nerves are not subjected to the influence of mind; and the mind often by its own inattention may lose the power which it originally possessed over nerves. Many persons can move the muscles of the ear, and others may have lost that power through neglect. After Fontana had observed that the heart was a voluntary muscle in a wheel polype, he learned to retard and accelerate the motions of his own at pleasure. If some nerves, from a sort of prescription, thus cease to be obedient to the power of mind, others by frequent service and habit become so obedient as to convey their stimuli to the muscles almost without the consciousness of mind. The motions excited by the stimuli of nerves are in many cases exceedingly rapid. These may be seen in the wings of most insects, but are most noticed in dancers, tumblers, and apes, and all those animals that are exhibited for feats of agility.

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The motions which we see excited in the body by the stimuli of nerves have often been so vigorous and prompt, as to have torn the muscle from the bone, and to have broken the bone itself. They often affect the organs of secretion, have often unhinged the fabric of the system, occasioned death, and accounted for the miracles that have been ascribed to the power of fancy. The prompt motions of what have been named sensitive plants seem owing to a different species of stimulants acting on extremely irritable fibres. In many instances the prompt motions of animals seem more owing to the irritability of their fibres than to what has been called the sensibility of their nerves. The poet was mistaken when he supposed that the mangled insect would feel as sensibly as a mangled giant. When the gad-fly fixes fairly on the hand, you may cut off its wings, its legs, its antennæ, and a part of the lower division of its body, without disturbing its gratification, or apparently occasioning to it much trouble.

In the animal kingdom all muscles in the time of action are observed to discharge a quantity of their blood; and those muscles which are naturally white are the most irritable. In all living bodies, the irritable power will cease to obey the action of a stimulant if either long or violently applied. After exercise, therefore, the irritable fibre requires rest, after heat cold, after waking sleep, before it again becomes submissive to the action of the stimulant that overwhelmed it. This is the reason that in plants and animals there are certain exertions and functions of the system that can only be continued at intervals and seasons. The natural stimuli of involuntary muscles continue to act, and the muscles continue to obey, through life.

The organs of sense were formed to mark the difference of stimulants; yet living bodies are affected by light without having eyes, by sounds without having ears, by odorous effluvia without having smell, and by sapid bodies without having taste. It is easily conceived how these objects, by their inherent properties or motion, may produce a confused sort of excitement in every highly-irritable fibre. But the organs of sense are peculiarly fitted to receive accurate and distinct impressions from each of these objects; and these different impressions seem not to arise from any difference in the kind of nerves by which they are received. All the difference that has been observed arises from the structure of the organ itself, and from the manner in which the nerve is distributed through it. Other parts of the animal body, as the stomach, the fauces, and genital organs, are thus affected by particular stimulants; and many animals, and even vegetables, may be affected in various manners, and by various stimulants, of which neither our feelings nor our senses can give intimation of any thing analogous.

With respect to the several organs of sense, some animals have many eyes without any motion, and some animals have few eyes with varieties of motion. The entrance to the ear in some animals is from the mouth, as happens in the frog; and the bones of the ear are without the cranium, as in some fishes. The sense of smelling is found in the nose: this sense is astonishing in dogs; and even sheep, in distinguishing their lambs, trust to it more than to seeing or hearing. The sense of taste is far from being general; and the sense of touch can hardly be said to reside peculiarly in any one organ.

CURIOUS

CURIOUS PARTICULARS ON THE MARCH OF THE BRITISH
EMBASSY THROUGH CHINA.

AT two o'clock in the morning of Wednesday, 21 August, 1793, the generale was beat through all the courts of the house, as a signal for the suite to prepare for their departure. After an hasty breakfast, the whole of the embassy was ready to proceed on their journey. The soldiers were first marched off to covered waggons provided for them; the servants then followed, and were received into similar machines; the gentlemen of the suite next proceeded in light carts drawn by a single horse. Lord Macartney, Sir George Staunton, and Mr. Plumb the interpreter, were conveyed in palanquins, which were each of them borne by four men.

The vehicles which carried the soldiers and servants were common hired carts, drawn by four horses, unequally coupled together, and covered with straw matting. The harness, if it may deserve that name, was made of rope and cordage. The single-horse carts were covered with blue nankeen, and had doors of lattice work lined with the same stuff: the drivers walked by the side of them.

At four o'clock this procession was in motion, which consisted of sixty carts for the soldiers and servants, and twenty for the conveyance of the gentlemen belonging to the suite, exclusive of carts for the private baggage, and the coolies, or porters, employed to carry the presents and heavy baggage, which were conveyed on their shoulders; four hundred of whom were employed on this extraordinary occasion.

About five o'clock we had quitted the city of Tong-tchew, and entered immediately into a fine level country of the most luxuriant fertility, which, as far as the eye could reach, appeared to be one immense garden.

The road along which we travelled, is not only broad, but elegant; and is a proof of the labour employed by the Chinese government to facilitate the communications between the capital and the principal part of the kingdom. The middle of this road consists of a pavement of broad flag-stones about twenty feet wide, and on each side of it there is sufficient space to admit of six carriages to run abreast. The lateral parts are laid with gravel stones, and kept in continual repair by troops of labourers, who are stationed on different parts of the road for that purpose.

At seven o'clock the cavalcade stopped at a large town, whose name is Kiyeng-Foo. To call it populous, would be to employ a superfluous expression, that is equally appropriate to the whole kingdom, as every village, town, and city, nay, every river, and all the banks of it, teems with people. In the country through which we passed the population is immense and universal: every mile brought us to a village, whose inhabitants would have crowded our largest towns; and the number of villas scattered over the country, on each side of the road, while they added to its beauty, were proofs of its wealth.

Those villas which we approached near enough to examine as we passed, were built of wood, and the fronts of many of them were painted black, and enriched with gilded ornaments.

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The day of our journey from Tong-tchew to Pekin was, I doubt not, a matter of general notification, from the prodigious concourse of people who absolutely covered the road; and, notwithstanding the utmost exertions of the mandarins to keep it clear, the pressure of the crowd was sometimes so great, that we were obliged to halt, for at least a quarter of an hour, to prevent the accidents which might otherwise have happened from the passage of the carts amid this continual and innumerable throng. I cannot but add to the obstacles which we received from the curiosity of the Chinese, some small degree of mortification at the kind of impression our appearance seemed to make on them: for they no sooner obtained a sight of any of us, than they universally burst out into immoderate shouts of laughter: and I must acknowledge, that we did not, at this time, wear the appearance of people, who were arrived in this country in order to obtain, by every means of address and prepossession, those commercial privileges, and political distinctions, which no other nation has had the art or power to accomplish.

At Kiyeng-Foo, which is about nine miles from Tong-tchew, the whole embassy of all ranks alighted from their respective carriages: here the inferior department found tables spread for their refreshment in an open yard, but covered, at the same time, with great plenty of cold meats, tea, fruits, &c. while the upper departments were served with their regale in some adjoining rooms of a very miserable appearance.

Before the procession re-commenced its progress, the conducting mandarin, with his usual attention, ordered some joau, a harsh four white wine, to be ordered to the attendants of the embassy, to fortify their stomachs, as a considerable time might probably elapse before they would obtain any further refreshment: we were then summoned to prepare for our departure, when a scene of confusion and disturbance took place among ourselves, which, whatever its real effects might have been, was not calculated at least to give any very favourable impression of the manners and disposition of the English nation. In short, from the crowd of people assembled to see us, the neglect of a previous arrangement, and distribution of the carts, together with the inconsiderate eagerness to set off among ourselves, it was a matter of no inconsiderable difficulty for the mandarins to assign the people to their respective vehicles.

At eight o'clock we took our leave of the town of Kiyeng-Foo, which is a very considerable and extensive place: the streets are broad and unpaved, and the houses are built altogether of wood; at least in the part which we traversed there were none constructed of any other materials. The shops made a very pleasing appearance, and seemed to be well furnished with their respective commodities.

Of the country, which occupies the few miles from this place to Pekin, I have little to say, as the crowds of people that surrounded us, either intercepted the view, or distracted our attention.

At noon we approached the suburbs of the capital of China, and I cannot but feel some degree of regret, that no alteration was made in the ordinary travelling and shabby appearance of the embassy, on such an important occasion. Whatever there might be to prevent that display which it possessed such ample provisions to make, I cannot pretend to determine; but our cavalcade had nothing like the appearance of an embassy, from the first nation in Europe, passing through the most populous city in the world.

On entering the suburbs, we passed beneath several very beautiful triumphal arches, elegantly painted, and enriched with various fanciful ornaments: the upper part of them was square, with a kind of pent-house, painted of a green colour, and heightened with varnish; from the inside of this roof was suspended the model of an accommodation junk, admirably executed, and adorned with ribbands and silken streamers.

These suburbs are very extensive; the houses are of wood, the greater part of them two stories in height, and their fronts painted in various colours. The shops are not only commodious for their respective purposes, but have a certain grandeur in their appearance, that is enlivened by the very pretty manner in which the articles of the respective magazines are displayed to the view of the public, either to distinguish the different trades, or to tempt the purchasers.

We proceeded gradually through spacious streets, which are paved on either side for the convenience of foot passengers. The whole way was lined with soldiers, and, indeed, without such a regulation, it would have been impossible for the carriages to have proceeded, from the crowd that attended us.

At two o'clock we arrived at the gates of the grand imperial city of Peking, with very little semblance of diplomatic figure or importance: in short, for I cannot help repeating the sentiment, the appearance of the ambassador's attendants, both with respect to the shabbiness of their dress, and the vehicles which conveyed them, bore a greater resemblance to the removal of paupers to their parishes in England, than the expected dignity of the representative of a great and powerful monarch.

Peking, or, as the natives pronounce it, Pitchen, the metropolis of the Chinese empire, is situated in one hundred and sixteen degrees of east longitude, and between forty and forty-one degrees of north latitude. It is defended by a wall that incloses a square space of about twelve leagues in circumference: there is a grand gate in the center of each angle, and as many smaller ones at each corner of the wall; they are strongly arched, and fortified by a square building, or tower, of seven stories, that springs from the top of the gateway; the sides of which are strengthened by a parapet wall, with port-holes for ordnance. The windows of this building are of wood, and painted to imitate the muzzle of a great gun, which is so exactly represented, that the deception is not discoverable but on a very near approach: there are nine of these windows to each story on the front towards the suburbs. These gates are double; the first arch of which is very strongly built of a kind of free-stone, and not of marble, as has been related by some writers: the depth of it is about thirty feet, and in the middle of the entrance is a very strong door of six inches thick, and fortified with iron bolts: this archway leads to a large square, which contains barracks for soldiers, consisting of mean wooden houses of two stories: on turning to the left, the second gateway is seen, whose arch is of the same dimensions and appearance as that already described, but without the tower.

At each of the principal gates there is a strong guard of soldiers, with several pieces of ordnance placed on each side of the inner entrance. These gates are opened at the dawn of day, and shut at ten o'clock at night, after which hour all communication with the city from the suburbs is impracticable: nor will they be opened on any pretence.

pretence, or occasion, whatever, without a special order from the principal mandarin of the city.

The four smaller gates are defended by a small fort built on the wall, which is always guarded by a body of troops.

The wall is about thirty feet high, and ten feet in breadth on the top; the foundation of stone, and appears about two feet from the surface of the earth: the upper part is of brick, and gradually diminishes from the bottom to the top. Whether it is a solid structure, or only filled up with mortar or rubbish, is a circumstance concerning which I could not procure any authentic information.

This wall is defended by outworks and batteries, at short distances from each other; each of them being strengthened by a small fort, though none of the fortifications are garrisoned but those which are attached to the gates; and though there is a breast-work of three feet high, with port-holes for cannon, which crowns the whole length of the wall, there is not a single gun mounted upon it. On the side toward the city, it is, in some places, quite perpendicular; and in others, forms a gentle declivity from the top to the ground. It is customary for bodies of soldiers to patrol the wall every night during the time that the emperor resides in the city, which is from October to April, when his imperial majesty usually goes to a favourite palace in Tartary. From its perfect state of repair and general appearance, I should rather suppose it to be of modern erection, and that many years cannot have passed away since it underwent a complete repair, or was entirely rebuilt.

The distance from the south gate, where we entered, to the east gate, through which we passed out of the city, comprehends, on the most moderate computation, a course of ten miles. The principal streets are equally spacious and convenient, being one hundred and forty feet in breadth, and of great length, but are only paved on each side for foot passengers. The police of the city, however, spares no pains to keep the middle part clean, and free from all kind of nuisance; there being large bodies of scavengers continually employed for that purpose, who are assisted, as well as controlled, in their duty by soldiers stationed in every district, to enforce a due observance of the laws that have been enacted, and the regulations which have been framed, for preserving civil order among the people, and the municipal economics of this immense city. I observed, as we passed along, a great number of men who were sprinkling the streets with water, in order to lay the dust, which, in dry weather, would not only be troublesome to passengers, but very obnoxious also to the shops; whose commodities must be more or less injured, were it not for this beneficial and necessary precaution.

Though the houses at Pekin are low and mean, when considered with respect to size and domestic accommodation, their exterior appearance is very handsome, and elegant, as the Chinese take a great pride in beautifying the fronts of their shops and dwellings; the upper part of the former is ornamented with a profusion of golden characters; and on the roofs of the latter are frequent galleries, rich in painting and other decoration; where numerous parties of women are seen to amuse themselves according to the fashion of the country. The pillars, which are erected before the doors of the shops, are gilded and painted, having a flag fixed at the top, whose characters specify

the name and business of the owner: tables are also spread with commodities, and lines attached to these pillars are hung with them.

I observed a great number of butchers shops, whose mode of cutting up their meat resembles our own; nor can the markets of London boast a better supply of flesh than is to be found in Pekin. My curiosity induced me to inquire the prices of their meat, and, on my entering the shop, I saw on a stall before it an earthen stove, with a grid-iron placed upon it; and, on my employing a variety of signs to obtain the information I wanted, the butcher instantly began to cut off small thin slices of meat, about the size of a crown piece, and broiled as fast as I could eat them. I took about a dozen of these slices, which might all together weigh seven or eight ounces; and when I paid him, which I did by giving him a string of *caxee*, or small coin, he pulled off, as I suppose, the amount of his demand, which was one *conderon*, or ten *caxee*, the only current money in the empire. I saw numbers of people in other butchers shops, as I passed along, regaling themselves with beef and mutton in the same manner.

The houses for porcelain utensils and ornaments are peculiarly attractive, having a row of broad shelves, ranged above each other, on the front of their shops, on which they dispose the most beautiful specimens of their trade in a manner full of fancy and effect.

Beside the variety of trades which are stationary in this great city, there are many thousands of its inhabitants who cry their goods about, as we see in our own metropolis. They generally have a bamboo placed across their shoulders, and a basket at each end of it, in which they carry fish, vegetables, eggs, and other similar articles. There are also great numbers of hawkers and pedlars, who go about with bags strapped on their shoulders like a knapsack, which contain various kind of stuff-goods, the folds of which are exposed to view. In selling those stuffs, they use the cubit measure of sixteen inches. Barbers also are seen running about the streets in great plenty, with every instrument known in this country for shaving the head and cleansing the ears: they carry with them, for this purpose, a portable stove, and a small vessel of water; and whoever wishes to undergo either of these operations, sits down in the street, while the operator performs his office, for which he receives a mace. To distinguish their profession, they carry a pair of large steel tweezers, which they open with their fingers, and let them close again with some degree of violence, which produces a shrill sound that is heard at a considerable distance; and such is their mode of seeking employment. That this trade in China is a very profitable one may be pronounced, because every man must be shaved on a part of the head where it is impossible to shave himself.

In several of the streets I saw persons engaged in selling off goods by auction: the auctioneer stood on a platform surrounded with the various articles he had to sell; he delivered himself in a loud and bawling manner, but the smiling countenances of the audience, which was the only language I could interpret, seemed to express the entertainment they received from his harangue.

At each end of the principal streets, for there are no squares in Pekin, there is a large gateway fancifully painted, with a handsome roof coloured and varnished; beneath which the name of the street is written in golden characters: these arches terminate the nominal street, or otherwise there would be streets in some parts of the city
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of at least five miles in length, which are formed into several divisions by these gateways. They are very handsome, as well as central objects, and are railed in on each side from the foot pavement.

The narrow streets are inclosed at each end with small lattice gates, which are always shut during the night; but all the considerable streets are guarded both night and day by soldiers, who wear swords by their sides, and carry long whips in their hands, to clear the streets of any inconvenient throng of people, and to chastise such as are refractory in ordinary decorum or good behaviour.

Notwithstanding the vast extent of this place, there is little or no variety in their houses, as I have before observed, but in the colours with which they are painted; they are in reality nothing better than temporary booths, erected entirely for exterior show, and without any view to strength or durability. It is very rare, indeed, to see a house of more than one story, except such as belong to mandarins, and even those are covered, as it were, by the walls which rise above every house or building in Pekin, except a lofty pagoda, and the imperial palace.

There are no carriages standing in the streets for the convenience of the inhabitants, like our hackney coaches in London: the higher classes of people keep palanquins, and others of less distinction have covered carts drawn by a horse or mule.

The opinion, that the Chinese women are excluded from the view of strangers, has very little if any foundation, as among the immense crowd assembled to see the cavalcade of the English embassy, one-fourth of the whole at least were women; a far greater proportion of that sex than is to be seen in any concourse of people whom curiosity assembles in our own country: and if the idea is founded in truth, that curiosity is a peculiar characteristic of the female disposition in Europe, I shall presume to say, that, from the eagerness which we observed in the looks of the Chinese women as we passed by them, that the quality which has just been mentioned is equally prevalent among the fair ones of Asia.

The women we saw on our passage through Pekin possessed, in general, great delicacy of feature, and fair skins by nature, with which, however, they are not content, and therefore whiten them with cosmetics; they likewise employ vermilion, but in a manner wholly different from the application of rouge among our European ladies, for they mark the middle of their lips with it by a stripe of its deepest colour, which, without pretending to reason upon it, certainly heightened the effect of their features. Their eyes are very small, but powerfully brilliant, and their arms extremely long and slender. The only difference between the women of Pekin, and those we had already seen, as it appeared to us, was, that the former wear a sharp peak of black velvet or silk, which is ornamented with stones, and descends from the forehead almost between their eyes; and that their feet, free from the bandages which have already been mentioned, were suffered to attain their natural growth.

When we had passed through the eastern gate of the city, some confusion having arisen among the baggage-carts, the whole procession was obliged to halt. I, therefore, took the opportunity of easing my limbs, which were much cramped by the inconvenience of the machine; and, perceiving a number of women in the crowd that surrounded us, I ventured to approach them; and, addressing them with

with the Chinese word *Chou-an*, (or beautiful) they appeared to be extremely diverted, and gathering round me, but with an air of great modesty and politeness, they examined the make and form of my clothes, as well as the texture of the materials of which they were composed.

When the carts began to move off, I took leave of these obliging females by a gentle shake of the hand, which they tendered to me with the most graceful affability; nor did the men, who were present, appear to be at all dissatisfied with my conduct, but, on the contrary, expressed, as far as I could judge, very great satisfaction at this public attention I paid to their ladies. It appears, therefore, that in this city, the women are not divested of a reasonable portion of their liberty, and, consequently, that the jealousy attributed so universally to the Chinese men, is not a predominant quality, at least, in the capital of the empire.

Among other objects, which we saw in our way, and did not fail to attract our notice, we met a funeral procession, which proved to be a very striking and solemn spectacle: the coffin is covered by a canopy decorated with curtains of satin, enriched with gold and flowers, and hung with escutcheons: it is placed on a large bier or platform, and carried by at least fifty or sixty men, who support it on their shoulders with long bamboos crossing each other, and march eight abreast with slow and solemn step. A band of music immediately follows, playing a kind of dirge, which was not without a mixture of pleasing tunes: the relations and friends of the deceased person then followed, arrayed in black and white dresses.

Having passed through the eastern suburbs of the city, we entered into a rich and beautiful country, when a short stage of about four miles brought us to one of the emperor's palaces named Yeumen-man-yeumen, where we arrived about five o'clock in the afternoon, oppressed with fatigue from the extreme heat of the day, and the various impediments which obstructed our passage, arising from the immense crowds of people that may be said to have filled up the whole way from Tong-tchew to this place, a journey of thirty miles.

In a short time after our arrival, we received a very scanty and indifferent refreshment, when the whole suite retired to sleep off the fatigue of the day.

SURPRISING INSTANCES OF STRENGTH OF MEMORY.

THERE dwelt at Padua, (says Muretus,) a young man of Corsican extraction; born, as was reported, and as seemed credible, of an honourable family among his countrymen; who had come there to learn the civil law, in which study he had passed some years, with such diligence and attention, that men had formed a high opinion of his learning. He used to come almost every day to my house as the sun was going down, for it was summer, and there, the house being sufficiently spacious and open to the sun, either walking abroad in the air, and discoursing in a very agreeable manner with his equals, or exercising his body either with leaping, or wrestling, or playing at balls, repaired his strength, wearied by the labour of his studies, in a manner very much like a gentleman. There was a rumour that he possessed a certain art of memory, by the help
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of which he could do many things, which, unless actually seen, would not be credited. When that rumour reached my ears, I became desirous of seeing those wonderful and unheard-of things. For I am least of any one apt to be credulous on hearing such reports; it therefore occurred to me, as he used my house at his own pleasure, to claim this of him as a kind of rent, that he would give, in my presence, some such specimen of his art as he could with convenience to himself. He, not at all displeased, replied, "that he would most willingly do it at my request." I also was pleased. Instantly, there being no delay on his side, all of us who were present, going into the next parlour, sat down together. I began to dictate to him words Latin, Greek, barbarous, some with meaning, some without; with so much variety, and so little connection with each other, and so many in number, that both myself in dictating the words, and the servant who had the charge to take them down in writing them, and the rest who were present in hearing and in waiting, were all in a wonderful manner tired. He alone, out of all the company, pleasant, and not in the least wearied, continued asking for more words; but when I myself said, that some limits should be fixed, and that I should be abundantly satisfied, if he should be able to repeat even half the words that had been spoken, he then, with his eyes being earnestly fixed on the ground, and the expectation of us all greatly raised, stood for some time silent. Why need I multiply words? I was witness to a fact the most wonderful; this extraordinary man, when he began to speak, gave us back every word in the same order in which he had received it, nearly without once hesitating, and without once stopping. Then beginning from the last word he repeated upwards; then, in the same manner as he repeated to the first, he repeated to the third and fifth, and so would do to all. In a word, whatever order any one desired him, did he repeat the whole without any error.

Having often made the same experiment afterwards, as I became more acquainted with him, I found it exactly true. He has himself sometimes assured me, and he was as far as possible from any degree of boasting, that he could repeat six thousand words in the same manner. And, what is more wonderful, every thing was so fixed in his mind, that he said he could, with very little pains, repeat whatever he had committed to memory. On making the experiment several days afterwards, I did certainly find it true.

When I was lately at the house of an intimate friend, where I used to spend many pleasant evenings, the conversation happened to turn on the famous Swedish calculator. I had never before heard of him, and listened with particular attention. Things were told of him, which I could never have believed, if I had not placed unlimited confidence in the narrator's veracity. My friend John Grennius promised to give me particulars of this extraordinary character, but this was from time to time deferred. On my return home, I reflected on the circumstances, and, being desirous of knowing every thing on the subject, I wrote to my friend, who sent me a transcript from a printed book concerning this Swede, which was to the following purport.

Lars Bergsten Granberg Norcopia Bagastadenfis, from the simplicity of his life, this personage is commonly called *Lars pa Jorden*. A most extraordinary though obscure man, whose faculties well deserve to be commemorated, although he has never been able to learn either to write, read, or comprehend the simplest incidents requiring the

the most ordinary skill and recollection. The monarchs of Sweden and Denmark have in vain bestowed very large sums to be expended on the cultivation of his mind; yet, his memory is such, that in a moment of time he is able to explain the most perplexed and complicated series of arithmetical numeration. Such, for instance, as how many grains of salt or pepper would be necessary to load a vessel, if so many grains will fit a cubic inch? A question which most skilful masters of the art will require some days to answer, he will resolve in the shortest period of time, from the operation of his mind alone. Let any one also tell him the day and hour of his nativity, and, with almost a glance of his mind, he will explain how many days, hours, and minutes, you have lived. A particular example of this man's skill is subjoined.

PROBLEM.—A merchant had 33, and 44, and 55, and 66, and 77, and 88, and 99, bears, each bear had the same number of cubs, each cub the same number of tails, on every tail were the like number of hairs, and the price of every hair was the same number of carolines. Required the value of these bears in carolines, and how many tons of gold that sum contains.

ANSWER.—Bears, 462. —Cubs, 213,444. —Tails, 98,611,128. —Hairs, 45,558,347,136. —Carolines, 21,047,953,604,832. —The weight of the carolines 70,159,845 tons, and 34,944, imperials.

Note.—Three carolines equal to one imperial, and the weight of 100,000 imperials one ton.

Seneca says of himself, that, by the mere effort of his natural memory, he was able to repeat two thousand words upon once hearing them, each in its own order, though they had no dependence or connexion.—After which he mentions a friend of his, Portius Latro, who retained in his memory all the declamations he had ever spoken, and never found his memory fail him even in a single word.—He also mentions Cyneas, ambassador to the Romans from King Pyrrhus, who, in one day, had so well learnt the names of his spectators, that the next day he saluted the whole senate, and all the populace assembled, each by his name.—Pliny says, that Cyrus knew every soldier in his army by name; and L. Scipio all the people of Rome.—Char-mipas, or Carneades, when required, it is said, would repeat any volume found in the libraries as readily as if he were reading.

Magliabechi had as singular a memory. To put it to a proof, a gentleman lent him a manuscript. Some time after it was returned, he came to him with a melancholy face, to inform him that it was lost. Magliabechi was not so much concerned; for he repeated exactly every word of the manuscript, which it is said he had perfectly retained. It is also said, that, when he quoted any author in conversation, he also mentioned the volume and the page.

The memory of the great Daguesseau, Chancellor of France, was extremely singular. Such were his retentive powers, according to M. Thomas, that it was sufficient for him to have read once attentively any poem, of tolerable length, to recite it correctly. It was in this manner he possessed most of the Greek poetry. At the age of 80, a man of letters having quoted an epigram of Martial incorrectly, he immediately recited the whole, confessing that he had not read the author since the age of twelve years. Sometimes he even retained what had been only read to him. Boileau one day recited a satire he had just composed: Daguesseau told him, coldly, that he knew the

place perfectly well; and to convince him of it, repeated it entire. The satirist, as may be supposed, was furiously agitated; but finished, however, in admiring the felicity of his memory.

Ubbo Emmius, professor at Groningen had a prodigious memory; difficult to be credited. It is related of him, that he could readily answer any questions in history without mistaking the minutest circumstances of time, place, or persons. He even recollected the figure, situation, and magnitude, of towns and fortresses; the position of the rivers and highways; the heights of the mountains, &c.

Dr. Wallis tells us, that, without the assistance of pen and ink, or any thing equivalent, he was able, in the dark, by mere force of memory, to perform arithmetical operations, as multiplication, division, extraction of roots, &c. to forty places. He particularly relates, that, in February, 1671, at the request of a foreigner, (by night, in bed,) he proposed to himself a number of fifty-three places, and found its square-root to twenty-seven places, and, without ever writing down the number, dictated it from his memory, at his next visit, twenty days afterwards.

In one of the periodical publications about thirty years ago, there is inserted an account of Jedidiah Buxton, who possessed the same singular faculty of going through very complicated operations of arithmetic, mentally.—The following is an example of Buxton's skill:

He was carried to the theatre one evening when Garrick performed; he fixed himself solely upon the employment of numbering the words he spoke; some kind of interruption disturbed him, at which he shewed much anger, but he nevertheless succeeded in what he undertook. One thing only went beyond the powers of his calculation; the number of steps made by the dancers.

I knew one of ninety, who forgot from day to day all that he saw, all that he heard, but who said, he remembered with ease the fields and the woods where he had kept sheep in his youth. The fibres we are accustomed to move from our infancy have a more durable mobility: exercise nourishes and strengthens them.

OF THE REPRODUCTION OF ANIMAL AND VEGETABLE LIFE.

IT is very well known that trees and plants may be raised from slips and cuttings; and some late observations have shewn, that there are some animals which have the same property. The polype was the first instance we had of this; but we had scarcely time to wonder at the discovery Mr. Trembley had made, when Mr. Bonett discovered the same property in a species of water-worm. Amongst the plants which may be raised from cuttings, there are some which seem to possess this quality in so eminent a degree, that the smallest portion of them will become a complete tree again.

It deserves inquiry, whether or not the great Author of nature, when he ordained that certain insects, as these polypes and worms, should resemble those plants in that particular, allowed them this power of being reproduced in the same degree? or, which is the same thing, whether this reproduction will or will not take place in whatever part the worm is cut? In order to try this, Mr. Bonett

entered on a course of many experiments on the water-worms which have this property. These are, at their common growth, from two to three inches long, and of a brownish colour, with a cast of reddish. From one of these worms he cut off the head and tail, taking from each extremity only a small piece of a twelfth of an inch in length; but neither of these pieces were able to reproduce what was wanting. They both perished in about twenty-four hours; the tail first, and afterwards the head. As to the body of the worm from which these pieces were separated, it lived as well as before, and seemed indeed to suffer nothing by the loss, the head-part being immediately used as if the head was thereon, boring the creature's way into the mud. There are, besides this, two other points in which the reproduction will not take place; the one of these is about the fifth or sixth ring from the head, and the other at the same distance from the tail; and in all probability the condition of the great artery in these parts is the cause of this.

What is said of the want of the reproductive power of these parts relates only to the head and tail ends; for, as to the body, it feels very little inconvenience from the loss of what is taken off, and very speedily reproduces those parts. Where then does the principle of life reside in such worms, which, after having their heads cut off, will have not only the same motions, but even the inclinations, that they had before? and yet this difficulty is very small, compared to several others which at the same time offer themselves to our reason. Is this wonderful reproduction of parts only a natural consequence of the laws of motion? or is there lodged in the body of the creature a chain of minute buds or shoots, a sort of little embryos, already formed and placed in such parts where the reproductions are to begin? Are these worms only mere machines? or are they, like more perfect animals, a sort of compound, the springs of whose motions are actuated or regulated by a sort of soul? And, if they have themselves such a principle, how is it that this principle is multiplied, and is found in every separate piece? Is it to be granted, that there are in these worms, not a single soul (if it is so to be called) in each, but that each contains as many souls as there pieces capable of reproducing perfect animals? are we to believe with Malpighi, that these sorts of worms are all heart and brain from one end to the other! This may be; but yet, if we know that it was so, we should know in reality but very little the more for knowing it: and it seems, after all, that in cases of this kind we are only to admire the works of the great Creator, and sit down in silence.

The nice sense of feeling in spiders has been much talked of by naturalists; but it appears that these worms have yet somewhat more surprising in them in regard to this particular. If a piece of stick, or any other substance, be brought near them, they do not stay for its touching them, but begin to leap and frisk about as soon as it comes towards them. There want, however, some farther experiments to ascertain whether this be really owing to feeling or to sight; for, though we can discover no distinct organs of sight in these creatures, yet they seem affected by the light of the sun or a candle, and always frisk about it in the same manner at the approach of either; nay, even the moon-light has some effect upon them.

A twig of willow, poplar, or many other trees, being planted in the earth, takes root, and becomes a tree, every piece of which will

In the same manner produce other trees. The case is the same with these worms: they are cut to pieces, and these several pieces become perfect animals; and each of these may be again cut into a number of pieces, each of which will in the same manner produce an animal. It had been supposed by some that these worms were oviparous; but Mr. Bonett, on cutting one of them to pieces, having observed a slender substance, resembling a small filament, to move at the end of one of the pieces, separated it; and on examining it with glasses, found it to be a perfect worm, of the same form with its parent, which lived and grew larger in a vessel of water into which he put it. These small bodies are easily divided, and very readily complete themselves again, a day usually serving for the production of a head to the part that wants one; and, in general, the smaller and slenderer the worms are, the sooner they complete themselves after this operation. When the bodies of the large worms are examined by the microscope, it is very easy to see the appearance of the young worms alive, and moving about within them: but it requires great precision and exactness to be certain of this; since the ramifications of the great artery have very much the appearance of young worms, and they are kept in a sort of continual motion by the systoles and diastoles of the several portions of the artery, which serve as so many hearts. It is very certain, that what we force in regard to these animals by our operations, is done also naturally every day in the brooks and ditches where they live. A curious observer will find in these places many of them without heads or tails, and some without either; as also other fragments of various kinds, all which are then in the act of completing themselves: but whether accidents have reduced them to this state, or they thus purposely throw off parts of their own body for the reproduction of more animals, it is not easy to determine. They are plainly liable to many accidents, by which they lose the several parts of their body, and must perish very early if they had not a power of reproducing what was lost: they often are broken into two pieces, by the resistance of some hard piece of mud which they enter; and they are subject to a disease, a kind of gangrene, rotting off the several parts of their bodies, and must inevitably perish by it, had they not this surprising property.

This worm was a second instance, after the polype, of the surprising power in an animal of recovering its most essential parts when lost. But nature does not seem to have limited her beneficence in this respect to these two creatures. Mr. Bonett tried the same experiments on another species of water-worm, differing from the former in being much thicker. This kind of worm, when divided in the summer-season, very often shews the same property; for, if it be cut into three or four pieces, the pieces will lie like dead for a long time, but afterwards will move about again; and will be found in this state of rest to have recovered a head, or a tail, or both. After recovering their parts, they move very little; and, according to this gentleman's experiments, seldom live more than a month.

It should seem, that the more difficult success of this last kind of worm, after cutting, and the long time it takes to recover the lost parts, if it do recover them at all, is owing to its thickness; since we always find, in that species of worms which succeeds best of all, that those which are thinnest always recover their parts much sooner than the others.

The water-insects also are not the only creatures which have this power of recovering their lost parts. The earth affords us some already discovered to grow in this manner from their cuttings, and these not less deserving our admiration than those of the water: the common earth-worms are of this kind. Some of these worms have been divided into two, others into three or four, pieces; and some of these pieces, after having passed two or three months without any appearance of life or motion, have then begun to reproduce a head or tail, or both. The reproduction of the anus, after such a state of rest, is no long work; a few days do it: but it is otherwise with the head, that does not seem to perform its functions in the divided pieces till about seven months after the separation. It is to be observed, that in all these operations, both on earth and water-worms, the hinder part suffers greatly more than the fore part in the cutting; for it always twists itself about a long time, as if actuated by strong convulsions; whereas the head usually crawls away without the appearance of any great uneasiness.

The reproduction of several parts of lobsters, crabs, &c. makes also one of the great curiosities in natural history. That, in lieu of an organical part of an animal broken off, another shall rise perfectly like it, may seem inconsistent with the modern system of generation, where the animal is supposed to be wholly formed in the egg. Yet has the matter of fact been well attested by the fishermen, and even by several virtuofos who have taken the point into examination, particularly M. de Reaumur and M. Perrault, whose skill and exactness in things of this nature will hardly be questioned. The legs of lobsters, &c. consist each of five articulations: now, when any of the legs happen to break by any accident, as in walking, &c. which frequently happens, the fracture is always found to be in a part near the fourth articulation; and what they thus lose is precisely reproduced some time afterwards; that is, a part of a leg shoots out, consisting of four articulations, the first whereof has two claws as before; so that the loss is entirely repaired.

If a lobster's legs be broken off by design at the fourth or fifth articulation, what is thus broken off always comes again; but it is not so if the fracture be made in the first, second, or third, articulation. In those cases, the reproduction is very rare if things continue as they are. But what is exceedingly surprising is, that they do not; for, upon visiting the lobsters maimed in these barren and unhappy articulations, at the end of two or three days, all the other articulations are found broken off to the fourth; and it is suspected they have performed the operation on themselves, to make the reproduction of a leg certain.

The part reproduced is not only perfectly like that retrenched, but also, in a certain space of time, grows equal to it. Hence it is that we frequently see lobsters, which have their two big legs unequal, and that in all proportions. This shews the smaller leg to be a new one.

A part thus reproduced being broken, there is a second reproduction. The summer, which is the only season of the year when lobsters eat, is the most favourable time for the reproduction. It is then performed in four or five weeks; whereas it takes up eight or nine months in any other season. The small legs are sometimes reproduced,

reproduced, but more rarely, as well as more slowly, than the great ones: the horns do the same. The experiment is most easily tried on the common crab.

OF RESEMBLANCE, AND DISSIMILITUDE.

THE connection that man hath with the beings around him, requires some acquaintance with their nature, their powers, and their qualities, for regulating his conduct. For acquiring a branch of knowledge so essential to our well-being, motives alone of reason and interest are not sufficient: nature hath providentially superadded curiosity, a vigorous propensity, which never is at rest. This propensity alone attaches us to every new object; and incites us to compare objects, in order to discover their differences and resemblances.

Resemblance among objects of the same kind, and dissimilitude among objects of different kinds, are too obvious and familiar to gratify our curiosity in any degree: its gratification lies in discovering differences among things where resemblance prevails, and resemblances where difference prevails. Thus a difference in individuals of the same kind of plants or animals, is deemed a discovery, while the many particulars in which they agree are neglected; and, in different kinds, any resemblance is greedily remarked, without attending to the many particulars in which they differ.

A comparison of the former neither tends to gratify our curiosity, nor to set the objects compared in a stronger light: two apartments in a palace, similar in shape, size, and furniture, make separately as good a figure as when compared; and the same observation is applicable to two similar compartments in a garden: on the other hand, oppose a regular building to a fall of water, or a good picture to a towering hill, or even a little dog to a large horse, and the contrast will produce no effect. But a resemblance between objects of different kinds, and a difference between objects of the same kind, have remarkably an enlivening effect. The poets, such of them as have a just taste, draw all their similes from things that in the main differ widely from the principal subject; and they never attempt a contrast, but where the things have a common genus, and a resemblance in the capital circumstances: place together a large and a small-sized animal of the same species, the one will appear greater, the other less, than when viewed separately: when we oppose beauty to deformity, each makes a greater figure by the comparison. We compare the dress of different nations with curiosity, but without surprise; because they have no such resemblance in the capital parts as to please us by contrasting the smaller parts. But a new cut of a sleeve, or of a pocket, enchants by its novelty; and, in opposition to the former fashion, raises some degree of surprise.

That resemblance and dissimilitude have an enlivening effect upon objects of sight, is made sufficiently evident; and that they have the same effect upon objects of the other senses, is also certain. Nor is that law confined to the external senses; for characters contrasted make a greater figure by the opposition: Iago, in the tragedy of Othello, says,

He

He hath a daily beauty in his life
That makes me ugly.

The character of a fop, and of a rough warrior, are no where more
Yuccessfully contrasted than in Shakespeare:

Hotspur. My liege, I did deny no prisoners:
But I remember, when the fight was done,
When I was dry with rage and extreme toil,
Breathless and faint, leaning upon my sword,
Came there a certain lord, neat, trimly dress'd,
Fresh as a bridegroom; and his chin, new reap'd,
Shew'd like a stubble-land at harvest-home.
He was perfum'd like a milliner;
And 'twixt his finger and his thumb he 'eld
A pouncet-box, which ever and anon
He gave his nose:—and still he smil'd and talk'd;
And, as the soldiers bare dead bodies by,
He call'd them untaught knaves, unmannerly,
To bring a slovenly unhandsome corse
Betwixt the wind and his nobility.
With many holiday and lady terms
He question'd me: among the rest, demanded
My pris'ners, in your majesty's behalf.
I then, all smarting with my wounds, being gall'd
To be so pester'd with a popinjay,
Out of my grief, and my impatience,
Answer'd, neglectingly, I know not what:
He should, or should not; for he made me mad,
To see him shine so brisk, and smell so sweet,
And talk so like a waiting gentlewoman,
Of guns, and drums, and wounds, (God save the mark!)
And telling me, the sovereign'st thing on earth,
Was parmacity for an inward bruise;
And that it was great pity, so it was,
This villanous saltpetre should be digg'd
Out of the bowels of the harmless earth,
Which many a good tall fellow had destroy'd
So cowardly: and, but for these vile guns,
He would himself have been a soldier.—

First Part of Henry IV. act 1. sc. 4.

Passions and emotions are also enflamed by comparison. A man
of high rank humbles the bystanders even to annihilate them in their
own opinion: Cæsar, beholding the statue of Alexander, was great-
ly mortified, that now, at the age of thirty-two, when Alexander died,
he had not performed one memorable action.

Our opinions also are much influenced by comparison. A man
whose opulence exceeds the ordinary standard is reputed richer than
he is in reality; and wisdom or weakness, if at all remarkable in an
individual, is generally carried beyond the truth.

The opinion a man forms of his present distress is heightened by
contrasting it with his former happiness:

————— Could I forget
What I have been, I might the better bear

What

What I am destin'd to. I'm not the first
 That have been wretched: but to think how much
 I have been happier. Innocent Adultery, act. 2.

The distress of a long journey makes even an indifferent inn agreeable: and, in travelling, when the road is good, and the horseman well covered, a bad day may be agreeable, by making him sensible how snug he is.

The same effect is equally remarkable, when a man opposes his condition to that of others. A ship tossed about in a storm makes the spectator reflect upon his own ease and security, and puts these in the strongest light.

A man in grief cannot bear mirth; it gives him a more lively notion of his unhappiness, and of course makes him more unhappy. Satan, contemplating the beauties of the terrestrial paradise, has the following exclamation:

With what delight could I have walk'd thee round,
 If I could joy in ought, sweet interchange
 Of hill and valley, rivers, woods, and plains,
 Now land, now sea, and shores with forest crown'd,
 Rocks, dens, and caves! but I in none of these
 Find place or refuge; and, the more I see
 Pleasures about me, so much more I feel
 Torment within me, as from the hateful siege
 Of contraries: all good to me becomes
 Bane, and in heav'n much worse would be my state.

Paradise Lost, book 9. l. 114.

The appearance of danger gives sometimes pleasure, sometimes pain. A timorous person upon the battlements of a high tower is seized with fear, which even the consciousness of security cannot dissipate. But upon one of a firm head this situation has a contrary effect: the appearance of danger heightens, by opposition, the consciousness of security, and consequently the satisfaction that arises from security: here the feeling resembles that above mentioned, occasioned by a ship labouring in a storm.

The effect of magnifying or lessening objects by means of comparison is to be attributed to the influence of passion over our opinions. This will evidently appear by reflecting in what manner a spectator is affected, when a very large animal is for the first time placed beside a very small one of the same species. The first thing that strikes the mind is the difference between the two animals, which is so great as to occasion surprise; and this, like other emotions, magnifying its object, makes us conceive the difference to be the greatest that can be: we see, or seem to see, the one animal extremely little, and the other extremely large. The emotion of surprise arising from any unusual resemblance serves equally to explain why at first view we are apt to think such resemblance more entire than it is in reality. And it must be observed, that the circumstances of more and less, which are the proper subjects of comparison, raise a perception so indistinct and vague as to facilitate the effect described; we have no mental standard of great and little, nor of the several degrees of any attribute; and the mind, thus unrestrained, is naturally disposed to indulge its surprise to the utmost extent.

In

In exploring the operations of the mind, some of which are extremely nice and slippery, it is necessary to proceed with the utmost circumspection: and, after all, seldom it happens that speculations of that kind afford any satisfaction. Luckily, in the present case, our speculations are supported by facts and solid argument. First, a small object of one species opposed to a great object of another, produces not, in any degree, that deception which is so remarkable when both objects are of the same species. The greatest disparity between objects of different kinds, is so common as to be observed with perfect indifference; but such disparity between the objects of the same kind, being uncommon, never fails to produce surprise; and, may we not fairly conclude, that surprise, in the latter case, is what occasions the deception, when we find no deception in the former? In the next place, if surprise be the sole cause of the deception, it follows necessarily that the deception will vanish as soon as the objects compared become familiar. This holds so unerringly, as to leave no reasonable doubt that surprise is the prime mover: our surprise is great, the first time a small lapdog is seen with a large mastiff; but when two such animals are constantly together, there is no surprise, and it makes no difference whether they be viewed separately or in company. We set no bounds to the riches of a man who has recently made his fortune; the surprising disproportion between his present and his past situation being carried to an extreme: but, with regard to a family that for many generations hath enjoyed great wealth, the same false reckoning is not made. It is equally remarkable, that a trite simile has no effect: a lover compared to a moth scorching itself at the flame of a candle, originally a sprightly simile, has by frequent use lost all force; love cannot now be compared to fire, without some degree of disgust. It has been justly observed against Homer, that the lion is too often introduced into his similes; all the variety he is able to throw into them not being sufficient to keep alive the reader's surprise.

To explain the influence of comparison upon the mind, we have chosen the simplest case, viz. the first sight of two animals of the same kind, differing in size only; but to complete the theory, other circumstances must be taken in. And the next supposition we make, is where both animals, separately familiar to the spectator, are brought together for the first time. In that case, the effect of magnifying and diminishing is found remarkably greater than in that first mentioned; and the reason will appear upon analysing the operation: the first feeling we have is of surprise at the uncommon difference of two creatures of the same species; we are next sensible, that the one appears less, the other larger, than they did formerly; and that new circumstances increasing our surprise, makes us imagine a still greater opposition between the animals, than if we had formed no notion of them beforehand.

Let us make one other supposition, that the spectator was acquainted beforehand with one of the animals only; the lapdog for example. This new circumstance will vary the effect; for, instead of widening the natural difference, by enlarging in appearance the one animal, and diminishing the other in proportion, the whole apparent alteration will rest upon the lapdog: the surprise to find it less than it appeared formerly, directs to it our whole attention, and makes us conceive it to be a most diminutive creature: the mastiff in the
mean

mean time is quite overlooked. To illustrate this effect by a familiar example :—Take a piece of paper or of linen tolerably white, and compare it with a pure white of the same kind : the judgment we formed of the first object is instantly varied ; and the surprise occasioned by finding it less white than was thought produces a hasty conviction that it is much less white than it is in reality : withdrawing now the pure white, and putting in its place a deep black, the surprise occasioned by that new circumstance carries us to the other extreme, and makes us conceive the object first mentioned to be a pure white : and thus experience compels us to acknowledge, that our emotions have an influence even upon our eye-sight. This experiment leads to a general observation, that whatever is found more strange and beautiful than was expected, is judged to be more strange and beautiful than it is in reality. Hence a common artifice, to depreciate beforehand what we wish to make a figure in the opinion of others.

The comparisons employed by poets and orators are of the kind last mentioned ; for it is always a known object that is to be magnified or lessened. The former is effected by likening it to some grand object, or by contrasting it with one of an opposite character. To effectuate the latter, the method must be reversed : the object must be contrasted with something superior to it, or likened to something inferior. The whole effect is produced upon the principal object ; which by that means is elevated above its rank, or depressed below it.

In accounting for the effect that any unusual resemblance or dissimilitude hath upon the mind, no cause has been mentioned but surprise ; and, to prevent confusion, it was proper to discuss that cause first. But surprise is not the only cause of the effect described : another occurs, which operates perhaps not less powerfully, viz. a principle in human nature that lies still in obscurity, not having been unfolded by any writer, though its effects are extensive : and, as it is not distinguished by a proper name, the reader must be satisfied with the following description. Every man who studies himself or others, must be sensible of a tendency or propensity in the mind to complete every work that is begun, and to carry things to their full perfection. There is little opportunity to display that propensity upon natural operations, which are seldom left imperfect ; but, in the operations of art it hath great scope : it impels us to persevere in our own work, and to wish for the completion of what another is doing : we feel a sensible pleasure when the work is brought to perfection ; and, our pain is not less sensible when we are disappointed. Hence our uneasiness when an interesting story is broke off in the middle, when a piece of music ends without a close, or when a building or garden is left unfinished. The same propensity operates in making collections ; such as the whole works, good and bad, of any author. A certain person attempted to collect prints of all the capital paintings, and succeeded except as to a few. La Bruyere remarks, that an anxious search was made for these ; not for their value, but to complete the set.

The final cause of the propensity is an additional proof of its existence. Human works are of no significance till they be completed ; and, reason is not always a sufficient counterbalance to indolence : some principle over and above is necessary to excite our industry, and to prevent our stopping short in the middle of the course.

We need not lose time to describe the co-operation of the foregoing propensity with surprise, in producing the effect that follows any unusual resemblance or dissimilitude. Surprise first operates, and carries our opinion of the resemblance or dissimilitude beyond truth. The propensity we have been describing carries us still farther; for it forces upon the mind a conviction, that the resemblance or dissimilitude is complete. We need no better illustration, than the resemblance that is fancied in some pebbles to a tree or an insect; which resemblance, however faint in reality, is conceived to be wonderfully perfect. The tendency to complete a resemblance acting jointly with surprise, carries the mind sometimes so far, as even to presume upon future events. In the Greek tragedy entitled *Phœnides*, those unhappy women, seeing the place where it was intended they should be slain, cried out with anguish, "They now saw their cruel destiny had condemned them to die in that place, being the same where they had been exposed in their infancy."

The propensity to advance every thing to its perfection, not only co-operates with surprise to deceive the mind, but of itself is able to produce that effect. Of this we see many instances where there is no place for surprise; and the first we shall give is of resemblance. *Unumquodque eodem modo dissolvitur quo colligatum est*, is a maxim in the Roman law that has no foundation in truth; for tying and loosing, building and demolishing, are acts opposite to each other, and are performed by opposite means: but, when these acts are connected by their relation to the same subject, their connection leads us to imagine a sort of resemblance between them, which by the foregoing propensity is conceived to be as complete as possible. The next instance shall be of contrast. Addison observes, "That the palest features look the most agreeable in white; that a face which is overflushed appears to advantage in the deepest scarlet; and that a dark complexion is not a little alleviated by a black hood." The foregoing propensity serves to account for these appearances; to make this evident, one of the cases shall suffice. A complexion, however dark, never approaches to black: when these colours appear together, their opposition strikes us; and the propensity we have to complete the opposition, makes the darkness of complexion vanish out of sight.

The operation of this propensity, even where there is no ground for surprise, is not confined to opinion or conviction: so powerful it is, as to make us sometimes proceed to action, in order to complete a resemblance or dissimilitude. If this appear obscure, it will be made clear by the following instance. Upon what principle is the *lex talionis* founded, other than to make the punishment resemble the mischief? Reason dictates, that there ought to be a conformity or resemblance between a crime and its punishment; and the foregoing propensity impels us to make the resemblance as complete as possible.

Persons in their last moments are generally seized with an anxiety to be buried with their relations. In the *Amynta* of Tasso, the lover, hearing that his mistress was torn to pieces by a wolf, expresses a desire to die the same death.

Upon the subject in general we have two remarks to add. The first concerns resemblance, which, when too entire, hath no effect, however different in kind the things compared may be. The remark is applicable to works of art only; for natural objects of different kinds

kinds have scarcely ever an entire resemblance. To give an example in a work of art: Marble is a sort of matter very different from what composes an animal; and marble cut into a human figure produces great pleasure by the resemblance: but, if a marble statue be coloured like a picture, the resemblance is so entire as at a distance to make the statue appear a real person: we discover the mistake when we approach; and no other emotion is raised, but surprise occasioned by the deception: the figure still appears a real person, rather than an imitation; and we must use reflection to correct the mistake. This cannot happen in a picture; for the resemblance can never be so entire as to disguise the imitation.

The other remark belongs to contrast. Emotions make the greatest figure when contrasted in succession; but then the succession ought neither to be rapid, nor immoderately slow: if too slow, the effect of contrast becomes faint by the distance of the emotions; and if rapid, no single emotion has room to expand itself to its full size, but is stifled, as it were, in the birth by a succeeding emotion. The funeral oration of the Bishop of Meaux upon the Duchess of Orleans is a perfect hodge-podge of cheerful and melancholy representations, following each other in the quickest succession: opposite emotions are best felt in succession; but each emotion separately should be raised to its due pitch, before another be introduced.

What is above laid down, will enable us to determine a very important question concerning emotions raised by the fine arts, viz. Whether ought similar emotions to succeed each other, or dissimilar? The emotions raised by the fine arts are for the most part too nearly related to make a figure by resemblance; and for that reason their succession ought to be regulated as much as possible by contrast. This holds confessedly in epic and dramatic compositions; and the best writers, led perhaps by taste more than by reasoning, have generally aimed at that beauty. It holds equally in music: in the same cantata all the variety of emotions that are within the power of music may not only be indulged, but, to make the greatest figure, ought to be contrasted. In gardening, there is an additional reason for the rule: the emotions raised by that art are at best so faint, that every artifice should be employed to give them their utmost vigour: a field may be laid out in grand, sweet, gay, neat, wild, melancholy, scenes; and, when these are viewed in succession, grandeur ought to be contrasted with neatness, regularity with wildness, and gaiety with melancholy, so as that each emotion may succeed its opposite: nay, it is an improvement to intermix in the succession rude uncultivated spots as well as unbounded views, which in themselves are disagreeable, but in succession heighten the feeling of the agreeable object; and we have nature for our guide, which in her most beautiful landscapes often intermixes rugged rocks, dirty marshes, and barren stony heaths. The greatest masters of music have the same view in their compositions: the second part of an Italian song seldom conveys any sentiment: and, by its harshness, seems purposely contrived to give a greater relish for the interesting parts of the composition.

A small garden, comprehended under a single view, affords little opportunity for that embellishment. Dissimilar emotions require different tones of mind; and therefore in conjunction can never be pleasant: gaiety and sweetness may be combined, or wildness and gloominess; but a composition of gaiety and gloominess is distasteful.

ful. The rude uncultivated compartment of furze and broom in Richmond garden, hath a good effect in the succession of objects; but a spot of that nature would be insufferable in the midst of a polished parterre or flower-plot. A garden, therefore, if not of great extent, admits not dissimilar emotions; and, in ornamenting a small garden, the safest course is to confine it to a single expression. For the same reason a landscape ought also to be confined to a single expression; and, accordingly it is a rule in painting, that if the subject be gay, every figure ought to contribute to that emotion.

It follows from the foregoing train of reasoning, that a garden near a great city ought to have an air of solitude. The solitariness, again, of a waste country ought to be contrasted in forming a garden; no temples, no obscure walks; but *jets d'eau*, cascades, objects active, gay, and splendid. Nay, such a garden should in some measure avoid imitating nature, by taking on an extraordinary appearance of regularity and art, to shew the busy hand of man, which in a waste country has a fine effect by contrast.

Wit and ridicule make not an agreeable mixture with grandeur. Dissimilar emotions have a fine effect in a slow succession; but in a rapid succession, which approaches to co-existence, they will not be relished. In the midst of a laboured and elevated description of a battle, Virgil introduces a ludicrous image, which is certainly out of its place:

Obvius ambustum torrem Chorinæus ab ara
Corripit, et venienti Ebuso plagamque ferenti
Occupat os flammis: illi ingens barba reluxit,
Nidoremque ambusta dedit.

Æn. xii. 298.

It would however be too austere to banish altogether ludicrous images from an epic poem. This poem doth not always soar above the clouds: it admits great variety; and, upon occasion, can descend even to the ground without sinking. In its more familiar tones, a ludicrous scene may be introduced without impropriety. This is done by Virgil in a foot-race: the circumstances of which, not excepting the ludicrous part, are copied from Homer. After a fit of merriment, we are, it is true, the less disposed to the serious and sublime: but then, a ludicrous scene, by unbending the mind from severe application to more interesting subjects, may prevent fatigue, and preserve our relish entire.

THE INSTRUCTIVE NATURALIST, No. VI.

OF MOTION, HABIT, AND TRANSFORMATION.

IRRITABILITY is one of the great sources of MOTION in all living bodies; and this power is brought into action immediately by nerves or some other stimulants. Locomotion here is principally considered; for, although the kinds of internal motion employed in secretion and the other functions be as remarkable, in the eye of the philosopher, they have not so generally attracted the attention. Most animals are capable by nature of changing the place which their body occupies; for this reason the irritable fibres being formed into bundles, which are called muscles, are in most animals attached to bones, cartilages, or hard integuments, which they move as levers: these

these levers, with their muscles attached, are in most cases formed into wings, fins, and legs of various kinds, and are employed in performing the motions of flying, swimming, walking, leaping, and creeping. So very necessary, in the opinion of some of the ancients, was one or other of these instruments to progressive motion, that the movement of the serpent was often ascribed to a preternatural cause, was supposed to resemble the *incessus deorum*, and procured to the animal one of the highest and most honourable ranks among the emblematic kinds of divinities. Even Moses himself, who was unwilling to allow it the character of an agathœmon or good genius, was yet so puzzled at its being able to move without feet, that he pronounces it a tool of the devil; and says that it was deprived of its feet by a curse from heaven for seducing mankind into idolatry. Notwithstanding, however, the surprise that has been occasioned by its singular movement, the motion of snails, though not so rapid, is in many respects as extraordinary: they adhere by a certain viscid secretion; on dry ground this secretion forms a pavement over which they glide; and they proceed by the action of muscles, without bone, cartilage, or shell, to which these muscles can be attached.

No animal walks without legs or flies without wings; but there are many that swim without fins, and that leap and creep without any legs. The rapidity of movement is not proportioned to the number of instruments that are employed: if the spout-fish be observed to move slowly with one leg, the sea urchin moves still slower with many thousands; the oyster moves by squirting out water; the scallop by the jerk of its shell, and when in the water it rises to the surface and sails before the wind.

Many animals are formed by nature to fly, walk, leap, and swim: the fate of those is rather uncommon whose muscles or feet are by nature attached to their integuments; the lobster is obliged to throw off its shell, and the caterpillar all its feet with the skin, and in that situation to remain stationary till it receive new instruments of motion.

Whoever has read the celebrated work *De Motu Animalium*, needs not to be told that, besides the organs which are here mentioned, the form, the structure, and even the specific gravity, of the body, as depending on the nature of the bones and muscles, or as varied by air, vesicles, and bubbles, with a great variety of other circumstances, are necessary to explain the different phenomena of locomotion.

As to vegetable motions, they evidently depend on external agents:—The motion of the wild oat has been mentioned; the wings of seeds only fit them to be carried by the wind, their specific gravity to float in the water, and their legs or tentacula to adhere to bodies that are in motion; the singular motions which have been ascribed to sleeping, to waking, to sensation, and volition, in the vegetable kingdom, seem only the consequence of light, heat, moisture, and such stimulants, acting invisibly or with secret influence; the opening and closing of the meteoric flowers are always correspondent to the states of the atmosphere; and the opening and closing of the equinoctial and tropic flowers, to the light, the length, or shortness, of the day.

The principal intentions of locomotion are to get food, to shun danger, to promote intercourse, and disperse the species.

HABIT, under the present consideration, deviates a little from its usual meaning. We employ it to signify that principle in living bodies

bodies by which they accommodate themselves to circumstances, assume as it were a different nature, and in many respects undergo a species of transformation.

So very much do some individuals of the vegetable tribe accommodate themselves to different situations, to soil, to climate, and the state of cultivation, that those naturalists who have not been accustomed to nice and accurate discriminations, have frequently mistaken the variations of the same plant for so many species. These variations may be daily seen by examining the plant as it grows on the mountains, in the valleys, in the gardens, or in the fields; or by bringing it from a rude uncultivated state, when it sometimes lays aside its formidable prickles, and changes the colour and structure of its flowers.

In the plant and animal, the delicacy and vigour of the constitution are oftener the effects of habit and circumstance than original conformation. We have mentioned already the varying colour of the integuments, and the purpose which it serves in changing with the seasons. We may here add, that animals covered with a down or hair have it thick or thin, long or short, according to the different exigencies of climate.

Those changes produced on their body are accompanied with others which are the causes of new tastes, of new propensities, and new manners. At the Cape of Good Hope the ostrich inclines to sit on her eggs day and night like any other bird; but in Senegal, where the heat is great, she is somehow disposed to leave them to the sun during the day. In those countries where provisions can be found during the greatest part of the year, the bee gradually loses the propensity of laying up stores for the season of winter; and in "those countries infested with monkeys, many birds (says an amusing and instructive writer), which in other climates build in bushes and the clefts of trees, suspend their nests upon slender twigs, and by this ingenious device elude the rapacity of their enemies." Man, from imitation, is exposed to a great number of habits peculiar to himself; and physical causes have ingeniously been assigned for the variety of his features and complexion.

Few experiments have yet been instituted with a view to shew how far this accommodating principle in nature may be extended in the different species of plants and animals. It is known, however, that the lamb and the dove can be made carnivorous; and that the hawk, laying aside his ferocity, can be brought by art to live upon grain.

Of all the effects of this singular principle, the most wonderful are those which are seen to take place with respect to generation. The fact is far from being new to the naturalist, that certain animals, oviparous at one season, are viviparous at another. This indicated much of accommodating power, though far inferior to what has been since witnessed and displayed: for who from all this could suspect, that any animal which usually propagates by an intercourse of sexes, could in any circumstance accommodate so far as to multiply its species another way. Bonnet of Geneva, however, has discovered, that the puceron or vine-fretter, which generally propagates by an intercourse of sexes, is not only oviparous at one period and viviparous at another, but, in all cases where the union of the sexes is not to be obtained, can easily accomplish all the purposes of generation without it. Similar experiments have likewise proved, that many

many plants can bring to maturity a productive seed, though the male parts of the flower be destroyed before they can in the usual way have any impregnating effect on the female. In this case the conclusions drawn have been somewhat new. From these experiments it has been inferred, that the sexual system is ill-founded, and that most of the learned naturalists of Europe are on this subject labouring at present under a mistake. This reasoning, however, is not satisfactory: for why, it might be asked, in the vegetable kingdom more than in the animal, should the mode of generation be necessarily uniform? Though some plants may, like some animals, propagate without sexual distinctions, the conclusion is not logical that these distinctions are useless in all; and though some few may, in particular instances, propagate without that impregnation to which they were accustomed, will any one demonstrate, that accommodating nature does not here as in the puceron adopt a new method to accomplish her designs?

In all living bodies, it frequently happens that several characteristic distinctions, as the colour, the features, and a number of diseases that are originally the effects of circumstance, do at last become so fixed in the system, that they are afterwards transmitted to posterity through some generations. Might not these facts reasonably claim the attention of those who mean to form matrimonial connections? How many might easily entail on their posterity hale constitutions, regular features, beautiful forms, sound minds, and tempers at once uniform and cheerful, who yet, from their sordid desire of wealth or their fond admiration of high rank, bequeath to them only scorbutic habits, deformed persons, disagreeable features, mean understandings, and forbidding tempers. Excepting the more extraordinary properties of body and mind, there are few that may not in some measure be transmitted to posterity: but nature seems unwilling that what is very eminent should ever be extended to a genus or a species; and therefore the sons of Cicero and Cromwell are only two of a thousand instances that might serve to prove, that neither extensive nor eccentric geniuses can be made hereditary:—In the second generation they often degenerate into minds that are weak, fatuous, or deranged; or into minds that are chiefly remarkable by their oddities and whims.

It has been observed by a pupil of Linnæus, that the apple-trees which are sent from Britain to New England blossom at first too early for the climate, and bear no fruit; and that it is only after some years that they conform to their situation: and this circumstance, by the way, explains why roots and seeds germinate sooner when brought from southern than when they are brought from northern latitudes. The very permanency of these effects has often been the cause of much confusion and error in philosophy: for the naturalist, mistaking the lasting though temporary qualities of habit for the real and essential qualities of species, has not unfrequently drawn conclusions from his experiments that have been contradicted by similar experiments in other circumstances. This is one of the obvious reasons why experiments exhibit so many inconsistencies and contradictions, and why we are amused with such a multitude of visionary theories about the properties of living bodies.

From not attending to the numerous circumstances that induce habits, and to that general accommodating principle in living bodies,
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many medical prescriptions are found to be not only useless but mischievous; and many parents, by studying the health and comfort of their children, bring on habits that prove the sources of perpetual sickness or the certain presages of an early death.

The accommodating principle is one of the consequences of irritability. Its various effects arise from the actions of different stimulants on the irritable fibre; and the after-duration of these effects, from the modifications of the irritable fibre, become habitual from the frequently-repeated action of the stimulants.

The design of this accommodating principle is to fit both the plant and the animal for a more extensive and a more varied range of existence.

More remarkably striking than any of those changes to which the plant and animal are exposed, from the variations of habit or the change of integuments, are those alterations which they undergo from metamorphosis or TRANSFORMATION. It has indeed been asserted, that these alterations consist in throwing off certain temporary covering or envelopes: but there is here a want of precision in the ideas, and consequently a want of accuracy in the expression. The same persons who make this assertion inform us, that caterpillars change their skin, and many of them even several times, previous to the period of their transformation. Transformation, therefore, and a change of integuments, by their own concessions, are different things. The truth is, transformation frequently takes place independent of any change of integuments; and there is often a change of the integuments without transformation or any appearance of a new form: but a new form or change of appearance is always implied in metamorphosis or transformation. This new form is sometimes occasioned by a change of shape, consistency, and colour; as when the lobes of a seed are converted into seminal leaves. It is sometimes occasioned by a change of proportions among the parts: the proportions of a foetus, every one sees, are different from those of a full-grown man; and the painter, merely by observing the proportions, represents a child, a dwarf, and a giant, on the same scale. It is sometimes occasioned by the addition of new organs; as when the emmet receives wings, and the plume of the seed is fed by new roots striking into the ground; or it is occasioned by a change of both the form and the organs, and their mode of operation, as happens remarkably in some insects: for though all living bodies, plants and animals, without exception, undergo partial or general transformations, yet these changes are chiefly observable among insects. Many insects appear to consist of two distinct animal bodies, one within the other: the exterior, a creature of an ugly form, residing in the water or under the earth, breathing by gills or sometimes by tracheæ projecting from the tail, possessing a voracious and groveling appetite, and having a system of sanguiferous vessels that circulates the blood towards the head. When all its parts decay and fall off, the creature inclosed succeeds in its stead: this often is an animal of a different form, generally lives in a different element, feeds on a different species of food, has different instruments of motion, different organs of sense, different organs of respiration, and differently situated; and, being endowed with the parts of generation, inclines to gratify the sexual propensity, and produces an embryo which becomes like the first, and from which afterwards in process of time a creature is evolved similar to itself.

If the embryo or egg be deposited on a leaf, the leaf frequently is observed to bend, to wrap it in folds intended for the purpose, and to protect it from injuries and danger. If deposited in the body of an animal or plant, they accommodate themselves to its wants and necessities, and furnish a tumour which serves it for a nidus, and besides, like an uterus, supplies it with nourishment; and, if deposited in the body of an insect, the creature provides for the future destination of its young charge with all the tender care of a parent, and then dies.

These circumstances, added to the great variety of forms which insects assume, render it sometimes difficult to know who is the parent. We cannot, for instance, pronounce with certainty who is the true parent of the gordius, known by the name of the *feta equina*, or hair-eel. We learn, from a number of observations, that certain black beetles about the end of the summer months have the strongest propensity to run into the water, where they soon die; and that one or two, and sometimes three or more, of those eels, gradually drop from the beetle by the anus. Whether other insects provide for the gordius in this manner we are not able to determine. The transmutations of some animals are most observable in the uterus and egg; and anatomy has often witnessed the change which happens at birth with respect to circulation, respiration, digestion, and the other functions.

If the reader wish to be much acquainted with the manners and transformations of insects, he will derive information and pleasure from consulting the plates and memoirs of Reaumur. If he wish to know their intimate structure, the laborious Swammerdam can introduce him to a new and amusing species of anatomy. This last author had before Reaumur defined and described the kinds of transmutations among insects and some other animals. He has shewn similar transmutations in plants; and, in plate 46 of his Book of Nature, has compared the frog and the clove July-flower under their six different forms.

In all living bodies possessed of mind, the changes of form, as well as the change of habit and age, are usually accompanied with new propensities, appetites, and passions. It may therefore be inferred, that we ought not to look for the cause of temper in either the brain or the nervous system; or to imagine, that the propensities, appetites, and passions, are properties of mind: they seem only affections happening to the mind in consequence of stimuli and organic structure. Microscopic observations having demonstrated, that all the forms of the plant and animal existed previously in the seed or embryo, transformation must be owing entirely to the evolution of the different parts by means of nutrition.

What nature intends by transformation, we pretend not to say; but by means of transformation different elements are peopled, the different seasons variously adorned, and animated nature wonderfully diversified without a multiplication of beings.

DESCRIPTION OF THE PEARL FISHERY.

PEARLS, though esteemed of the number of gems by our jewellers, and highly valued, not only at this time but in all ages, proceed only from a distemper in the creature that produces them,

analogous to the bezoars and other stony concretions in several animals of other kinds. The fish in which these are usually produced is the East Indian pearl-oyster, as it is commonly called. Besides this shell, there are many others that are found to produce pearls; as the common oyster, the muscle, and several others; the pearls of which are often very good; but those of the true Indian berberi, or pearl-oyster, are in general superior to all. The small or seed-pearls, also called ounce-pearls, from their being sold by the ounce and not by tale, are vastly the most numerous and common: but, as in diamonds, among the multitudes of small ones, there are smaller numbers and larger found, so in pearls there are larger and larger kinds; but, as they increase in size, they are proportionably less frequent; and this is one reason of their great price. We have Scotch pearls frequently as big as a little tare, some as big as a large pea, and some few of the size of a horse-bean; but these are usually of a bad shape, and of little value in proportion to their weight. Philip II. of Spain had a pearl perfect in its shape and colour, and of the size of a pigeon's egg. The finest, and what is called the true, shape of the pearl, is a perfect round; but if pearls of a considerable size are of the shape of a pear, as is not unfrequently the case, they are not less valued, as they serve for ear-rings and other ornaments. Their colour ought to be a pure white; and that not a dead and lifeless, but a clear and brilliant, one: they must be perfectly free from any foulness, spot, or stain; and their surfaces must be naturally smooth and glossy; for they bring their natural polish with them, which art is not able to improve.

All pearls are formed of the matter of the shell, and consist of a number of coats spread with perfect regularity one over another, in the manner of the several coats of an onion, or like the several strata of the stones found in the bladders or stomachs of animals, only much thinner:

There are two seasons for pearl-fishing: the first is in March and April, and the last in August and September; and, the more rain there falls in the year, the more plentiful are these fisheries. At the beginning of the season there are sometimes two hundred and fifty barks on the banks; the larger barks have two divers, and the smaller one. As soon as the barks arrive at the place where the fish lie, and have cast anchor, each diver binds a stone, six inches thick and a foot long, under his body; which serves him as a ballast, prevents his being driven away by the motion of the water, and enables him to walk more steadily under the waves. They also tie another very heavy stone to one foot, by which they are very speedily sent to the bottom of the sea: and, as the oysters are usually firmly fastened to the rocks, they arm their hands with leather mittens, to prevent their being wounded in pulling them violently off; but this task some perform with an iron rake. In the last place, each diver carries down with him a large net in the manner of a sack, tied to his neck by a long cord, the other end of which is fastened to the side of the bark. This net is to hold the oysters gathered from the rock, and the cord is to pull up the diver when his bag is full, or when he wants air.

In this equipage he sometimes precipitates himself sixty feet under water; and, as he has no time to lose, he no sooner arrives at
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the bottom, than he begins to run from side to side, tearing up all the oysters he meets with, and cramming them into his budget.

At whatever depth the divers are, the light is so great, that they easily see whatever passes in the sea; and, to their great consternation, sometimes perceive monstrous fishes, from which all their address in muddying the water, &c. will not always save them, but they unhappily become their prey: and, of all the dangers of the fishery, this is one of the greatest and most usual. The best divers will keep under water near half an hour, and the rest do not stay less than a quarter. During this time they hold their breath without the use of oils or any other liquors; only acquiring the habit by long practice. When they find themselves straitened, they pull the rope to which the bag is fastened, and hold fast by it with both hands; when those in the bark, taking the signal, heave them up into the air, and unload them of their fish; which is sometimes five hundred oysters, and sometimes not above fifty. Some of the divers need a moment's respite to recover breath: others jump in again instantly, continuing this violent exercise without intermission for several hours.

On the shore they unload their barks, and lay their oysters in an infinite number of little pits dug in the sand four or five feet square, raising heaps of sand over them to the height of a man; and in this condition they are left till the rain, wind, and sun, have obliged them to open, which soon kills them: upon this the flesh rots and dries, and the pearls, thus disengaged, fall into the pit on their taking out the shells. After clearing the pits of the grosser filth, they sift the sand several times in order to find the pearl; but, whatever care they take, they always lose a great many. After cleaning and drying the pearls, they are passed through a kind of sieve, according to their sizes; the smallest are then sold as seed-pearls, and the rest put up to auction, and sold to the highest bidder.

Though these ornaments are met with in all quarters of the globe, the most esteemed have always been those of Asia and the east coast of Africa. In the kingdom of Madura, which lies on the east of Malabar, there are many pearl fisheries. Tutukurin or Tutucorin is the principal, if not the only, city on the fishery coast. At the time the Portuguese were masters in these parts, the taking of oysters in the straits betwixt the Island of Ceylon and the continent was stiled, by way of excellence, *the fishery*, and very deservedly; for though some prefer the pearls taken near the Island of Baharen in the Persian Gulf, and those likewise found on the coast of China at Hainan, yet it might be very easily proved, from the comparison of the annual amount of those fisheries within this period, that they were very seldom superior to this of which we are speaking. It was one of the wisest points in the Portuguese policy, that, though they were really in possession of this beneficial commerce, yet they chose to dissemble it, and took all imaginable precautions in order to make the natives believe that they were perfectly free, and that their interposition was not so much the effects of authority as of good-will; it was for this reason that they never pretended to erect any fort either at Tutucorin or at Calipatnam, two towns upon the continent, from whence most of the fishers and their barks came, and that they suffered the ancient customs to take place.

The season of the fishery was the latter end of April or beginning of May, sometimes sooner, sometimes later, according to the weather. The direction of it was left entirely to the sovereign of the country, called the naik; and the Portuguese, in quality of the protectors of the sea, sent two frigates to defend the fishing vessels from the Malabar and Maldive pirates. The time which this pearl-fishing lasted was about a fortnight, of the beginning of which the naik gave public notice; and, the day being come, there repaired to the place assigned several thousands of people of all sexes and ages, and an indefinite number of fishing vessels, and divers from five or six hundred to a thousand or more. Upon a signal given, the boats put to sea; and, having chosen their proper stations, the divers plunged and brought up the oysters in little baskets upon their heads; with which the boats being sufficiently laden, they were carried on-shore, where the people who remained there for that purpose buried them in the sand, till, by the heat of the sun, the fish was corrupted and consumed, and the pearls easily taken out. The whole conduct of the first day's fishery belonged to the naik; and, after that deduction, what was caught every day was separated, and particularly distinguished, but went to the common profit. The whole number of the people employed at sea and on-shore amounted frequently to fifty or sixty thousand souls; and the pavilions and tents set up for their accommodation made a fine appearance at a distance. When the pearls were extracted, cleansed, and dried, they passed them through a kind of sieves, by which their sizes were distinguished. When all was over, the naik appointed a time and place for the public market; in consequence of which there was a kind of fair, that lasted commonly from the close of June till the beginning of September. The smallest, which are what we call seed-pearl, they sold by weight, and all the rest according to their respective sizes and beauty, from a few shillings up to ten or twenty pounds, and sometimes more, a-piece; but there were few buyers, except the Portuguese merchants, who, bringing ready money, had got bargains, and thus all parties were pleased. The Portuguese assumed the protection of this fishery very soon after they settled in the Indies, and held it till the year 1658, when, in consequence of their losses in Ceylon and elsewhere, it fell into the hands of the Dutch, who have remained in possession of it ever since.

The Dutch have changed this method, as we are informed by a person very well acquainted with their affairs. The course into which they have put it is, in few words, this:—The camp is sometimes held on the coast of Madura, upon the continent; sometimes on the island of Manar, which is in the hands of the Dutch, who, notwithstanding, follow the example of the Portuguese, and lay claim to no higher title than that of protectors of the fishery, in which quality their commissary is ever in the camp, as well as the naik or sovereign of the country, who is also the rajah of Tanjour. The oysters caught every day are put up in tuns or barrels, of which, when a certain number are full, they put them up to sale by way of auction; and the merchants bid according as they have an opinion of the oysters for the season: but the middle price is between thirty and forty shillings sterling per cask. When a merchant has bought such a lot as this, he carries it to his quarters; and after a certain number of days he proceeds to opening the oysters, but always in the
air,

for the stench is so great as to be almost insupportable. They open them over tubs, into which they pour what comes out of the oyster, as also that muddy water that remains in the cask; next they draw it out into cullenders of several sizes, and at length perhaps they find four or five shillings worth of pearls, sometimes to the value of ten or twelve pounds; so that it is a perfect lottery, by which, some few becoming rich, it betrays numbers into beggary. This pearl fishery, we are told, brings the Dutch company an annual tribute of 20,000*l*.

There are a variety of rivers great and small in Eastern Tartary considerable for pearl fishery; but these pearls, though much esteemed by the Tartars, would be little valued by Europeans, on account of their defects in shape and colour. The Emperor Kang-hi had several chaplets or strings of these pearls, each containing one hundred, which were very large, and exactly matched. There are many rivulets in Livonia which produce pearls almost equal in size and clearness to the Oriental ones. There are several fisheries both on the eastern and western coasts of Africa; the most considerable of which lie round some small islands over-against the kingdom of Sotola; but the people thus employed, instead of exposing the oysters to the warmth of the sun, which would induce them to open, lay them upon the embers; by which absurd method, those pearls which they catch contract a dull kind of redness, which robs them of their natural lustre as well as of their value. Pearl-fishing is performed by the women as well as the men; both being equally expert. In the sea of California also there are very rich pearl-fisheries. In Japan likewise there are found pearls of great price. Pearls are met with in all parts of the Red Sea in the Indian Ocean; on the low part of the coast of Arabia Felix, named Baharen, adjoining to the Persian Gulf. They are likewise found on the low coast about Gunibroom, to the eastward of the Persian Gulf; and many of the finest kind are met with on the coasts of Ceylon. They are most plentiful in the Baharen, between the coast of Arabia Felix and Ormus, whence they are transported to Aleppo, then sent to Leghorn, and circulated through Europe.

It has been very commonly supposed, that pearls are found in a kind of oysters; and such the pearl-fishes are called in part of the above account, extracted from the Universal History; but Mr. Bruce absolutely denies this, and informs us that there is no such fish as an oyster to be met with in the Red Sea in particular. They are indeed found in bivalve shells, of which there are three kinds commonly sought after by the pearl-fishers. One of these is a kind of muscle, now very rare; but whether more plentiful formerly than at present is not known: they are principally found in the north end of the Red Sea and on the Egyptian side; and Mr. Bruce informs us, that the only place in which he ever met with them was about Cosfair, and to the northward of it, where there was an ancient port called Myos Hermos, "which (says Mr. Bruce) commentators have called the port of the Mouse, when they should have translated it the harbour of the Muscle."

The second sort of shell is called Pinna. It is broad and semi-circular at the top, decreasing gradually until it turns sharp at the lower end, where the hinge is. The outside is rough and figured, of a beautiful red colour, and sometimes three feet long, and extremely

remely brittle; the inside lined with that beautiful substance called nacre, or mother-of-pearl.

The third kind of pearl-shell is the only one which can be said to bear any resemblance to the oyster; though even this is evidently of a different genus.

In a general view of the writings of Linnæus by Richard Pulteney, M. D. p. 42. it is said that Linnæus made a remarkable discovery relating to the generation of pearls: in the river pearl-muscle (*mya margaritifera*) a shell-fish, found in several rivers of Great Britain and Ireland; that this fish will bear removal remarkably well; and that in some places they form reservoirs for the purpose of keeping it, and taking out the pearl, which in a certain period will be renewed again. The discovery was a method which Linnæus found of putting these muscles into a state of producing pearls at his pleasure, though the final effect did not take place for several years; but that in five or six years after the operation, the pearl would have acquired the size of a vetch. Dr. Pulteney regrets that we are unacquainted with the means by which Linnæus accomplished this extraordinary operation, which was considered as important, since it is certain the author was rewarded with a munificent premium from the states of the kingdom on that account.

The colours of pearls are different according to the shells in which they are found. The first kind often produces those of a fine shape and excellent lustre, but seldom of that very fine colour which enhances their price. The second kind produces pearls having the reddish cast of the inner shell of the pinna, called mother-of-pearl; which seems to confirm the opinion of Reaumur, that the pearls are formed from the glutinous fluid which makes the first rudiments of the shell; and this kind of pearl is found to be more red as it is formed nearer the broad part of the shell, which is redder than the other end. Mr. Bruce is of opinion, that the pearl found in this shell is the penim or peninim of Scripture; and that this name is derived from its redness. "On the contrary (says he), the word pinna has been idly imagined to be derived from penna, a feather; as being broad and round at the top, and ending at a point, or like a quill, below. The English translation of the Scripture, erroneous and inaccurate in many things more material, translates this peninim by rubies, without any foundation or authority, but because they were both red, as are bricks or tiles, and many other things of base materials. The Greeks have translated it literally pina or pinna, and the shell they call pinnicus; and many places occur in Strabo, Theophrastus, Elian, and Ptolemy, which are mentioned as famous for this kind of pearl. I should imagine also, that, by Solomon saying it is the most precious of all productions, he means that this species of pearl was the most valued or the best known in Judea; for though we learn from Pliny that the excellency of pearls was their whiteness, yet we know that the pearls of a yellowish cast are those esteemed in India to this day, as the peninim or reddish pearl was in Judea in the days of Solomon. In Job, where all the variety of precious stones are mentioned, the translator is forced, as it were unwillingly, to render peninim pearls, as he ought indeed to have done in many other places where it occurs."

The third sort of shell produces pearls of extreme whiteness, which Bochart says are called *darra* or *dora* in Arabic; which seems

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to be a general term for all kinds of pearls in Scripture, whereas the peninim is one in particular. But, though the character of this pearl be extreme whiteness, we are told by Pliny that there are shades or differences of it. The clearest, he says, are those of the Red Sea; but the pearls of India have the colour of the flakes or divisions of the lapis specularis. The most excellent are those like a solution of alum, limpid, milky-like, and even with a certain almost imperceptible cast of a fiery colour. Theophrastus tells us, that these pearls are transparent, as the description of Pliny would lead us to imagine; but it is not so, and, if they were, it is apprehended they would lose all their beauty and value, and approach too much to glass. The value of these commodities depends upon their size, regularity of form, whether round or not, weight, smoothness, colour, and the different shades of that colour. The pearl-fishers say, that, when the shell is smooth and perfect, they never expect to find any pearls, but always do so when it has begun to be deformed and distorted. Hence it would seem, that, as the fish turned older, the vessels containing the juice for forming the shell, and keeping it in its vigour, grew weak and ruptured; and thence, from this juice accumulating in the fish, the pearl was formed, and the shell brought to decay, as supposed by Mr. Reaumur. If this be the case, it ought to be known by the form of the shell whether the pearl is large or small; and thus, the smaller ones being thrown back into the sea, a constant crop of large pearls might be obtained.

Pliny says that pearls are the most valuable and excellent of all precious stones; and, from our Saviour's comparing the kingdom of heaven to a pearl, it would seem that they really were held in such high estimation at that time. Mr. Bruce, however, is of opinion, that this extraordinary value was put only upon the very large kind: of which we are told, that Servilia, the mother of Marcus Brutus, presented one to Cæsar of the value of 50,000*l.* of our money; and Cleopatra dissolved one worth 250,000*l.* in vinegar, which she drank at a supper with Mark Antony.

OF THE PASSIONS OF THE HUMAN MIND.

THE common division of the passions into *desire* and *aversion*, *hope* and *fear*, *joy* and *grief*, *love* and *hatred*, has been mentioned by every author who has treated of them, and needs no explanation; but it is a question of some importance in the philosophy of the human mind, whether these different passions be each a degree of an original and innate disposition, distinct from the dispositions which are respectively the foundations of the other passions, or only different modifications of one or two general dispositions common to the whole race.

The former opinion is held by all who build their system of metaphysics upon a number of distinct internal senses; and the latter is the opinion of those who, with Locke and Hartley, resolve what is commonly called instinct into an early association of ideas. That without deliberation mankind instantly feel the passion of fear upon the apprehension of danger, and the passion of anger or resentment upon the reception of an injury, are truths which cannot be denied: and hence it is inferred, that the seeds of these passions are innate in the mind, and that they are not generated, but only swell to magnitude,

tude, on the prospect of their respective objects. In support of this argument, it has been observed, that children, without any knowledge of their danger, are instinctively afraid on being placed on the brink of a precipice; and that this passion contributes to their safety long before they acquire, in any degree equal to their necessities, the exercise of their rational powers. Deliberate anger, caused by a voluntary injury, is acknowledged to be in part founded on reason and reflection; but where anger impels one suddenly to return a blow, even without thinking of doing mischief, the passion is instinctive. In proof of this, it is observed, that instinctive anger is frequently raised by bodily pain, occasioned even by a stock or a stone, which instantly becomes an object of resentment, that we are violently incited to crush to atoms. Such conduct is certainly not rational, and therefore it is supposed to be necessarily instinctive.

With respect to other passions, such as the lust of power, of fame, or of knowledge, innumerable instances, says Dr. Reid, occur in life, of men who sacrifice to them their ease, their pleasure, and their health. But it is absurd to suppose that men should sacrifice the end to what they desire only as means of promoting that end; and therefore he seems to think that these passions must be innate. To add strength to this reasoning, he observes, that we may perceive some degree of these principles even in brute animals of the more sagacious kind, who are not thought to desire means for the sake of ends which they have in view.

But it is in accounting for the passions which are disinterested that the advocates for innate principles seem most completely to triumph. As it is impossible not to feel the passion of pity upon the prospect of a fellow-creature in distress, they argue, that the basis of that passion must be innate; because pity, being at all times more or less painful to the person by whom it is felt, and frequently of no use to the person who is its object, it cannot in such instances be the result of deliberation, but merely the exertion of an original instinct. The same kind of reasoning is employed to prove that gratitude is the exercise of an innate principle. That good offices are, by the very constitution of our nature, apt to produce good will towards the benefactor, in good and bad men, in the savage and in the civilized, cannot surely be denied by any one in the least acquainted with human nature. We are grateful not only to the benefactors of ourselves as individuals, but also to the benefactors of our country; and that, too, when we are conscious that from our gratitude neither they nor we can reap any advantage. Nay, we are impelled to be grateful even when we have reason to believe that the objects of our gratitude know not our existence. This passion cannot be the effect of reasoning, or of association founded on reasoning; for, in such cases as those mentioned, there are no principles from which reason can infer the propriety or usefulness of the feeling. That *public spirit*, or the affection which we bear to our country, or to any subordinate community of which we are members, is founded on instinct; is deemed so certain, that the man destitute of this affection, if there be any such, has been pronounced as great a monster as he who has two heads.

All the disinterested passions are founded on what philosophers have termed *benevolent affection*. Instead therefore of enquiring into the origin of each passion separately, let us listen to one of the finest

writers

writers as well as ablest reasoners of the age, treating of the origin of benevolent affection. "We may lay it down as a principle (says Dr. Reid), that all benevolent affections are in their nature agreeable; that it is essential to them to desire the good and happiness of their objects; and that their objects must therefore be beings capable of happiness. A thing may be desired either on its own account, or as the means in order to something else. That only can properly be called an object of desire which is desired upon its own account; and therefore I consider as benevolent those affections only which desire the good of their object ultimately, and not as means in order to something else. To say that we desire the good of others, only to procure some pleasure or good to ourselves, is to say that there is no benevolent affection in human nature. This indeed has been the opinion of some philosophers both in ancient and in later times. But it appears as unreasonable to resolve all benevolent affections into self-love, as it would be to resolve hunger and thirst into self-love. These appetites are necessary for the preservation of the individual. Benevolent affections are no less necessary for the preservation of society among men; without which men would become an easy prey to the beasts of the field. The benevolent affections planted in human nature, appear therefore no less necessary for the preservation of the human species than the appetites of hunger and thirst." In a word, pity, gratitude, friendship, love, and patriotism, are founded on different benevolent affections; which our learned author holds to be original parts of the human constitution.

This reasoning has certainly great force; and, if authority could have any weight in settling a question of this nature, we know not that name to which greater deference is due than the name of him from whom it is taken. Yet it must be confessed that the philosophers, who consider the affections and passions as early and deep-rooted associations, support their opinion with very plausible arguments.

"When an infant is born (says Dr. Sayers), there is every reason to suppose that he is born without ideas. These are rapidly communicated through the medium of the senses. The same senses are also the means of conveying to him pleasure and pain. These are the hinges on which the passions turn: and, till the child is acquainted with these sensations, it would appear that no passion could be formed in his mind; for, till he has felt pleasure and pain, how can he desire any object, or wish for its removal? How can he either love or hate? Let us observe then the manner in which love and hatred are formed; for on these passions depend all the rest. When a child endures pain, and is able to detect the cause of it, the idea of pain is connected in his mind with that of the thing which produced it; and, if the object which occasioned pain be again presented to the child, the idea of pain associated with it arises also. This idea consequently urges the child to avoid or to remove the object; and thus arises the passion of dislike or hatred. In the same manner, the passion of liking or love is readily formed in the mind of a child from the association of pleasant ideas with certain objects which produced them.

"The passions of hope and fear are states of the mind depending upon the good or bad prospects of gratifying love or hatred; and joy or sorrow arises from the final success or disappointment which attends the exertions produced by love or by hatred. Out of these

passions, which have all a perceptible relation to our own good, and are universally acknowledged to be selfish, all our other passions are formed."

To account for the passions called *disinterested*, he observes, that in the history of the human mind we find many instances of our dropping an intermediate idea, which has been the means of our connecting two other ideas together; and that the association of these two remains after the link which originally united them has vanished. Let us suppose, with Dr. Sayers, that any individual has done to us many offices of kindness, and has consequently much contributed to our happiness; it is natural for us to seek with some anxiety for the continuance of those pleasures which he is able to communicate. But we soon discern, that the surest way of obtaining the continuance of his friendly offices is to make them, as much as possible, a source of pleasure to himself. We therefore do every thing in our power to promote his happiness in return for the good he has conferred upon us, that thus we may attach him to us as much as we are able. Hitherto all is plainly selfish. We have been evidently endeavouring, for the sake of our own future gratification, to promote the happiness of this person; but observe the consequence. We have thus, by contemplating the advantage to be derived to ourselves from promoting the prosperity of our friend, learned to associate a set of pleasant ideas with his happiness; but the link which has united them gradually escapes us, while the union itself remains. Continuing to associate pleasure with the well-being of our friend, we endeavour to promote it for the sake of his *immediate* gratification, without looking farther; and in this way his happiness, which was first attended to only as a means of future enjoyment, finally becomes an end. Thus then the passion, which was originally selfish, is at length *disinterested*; its gratification being completed merely by its success in promoting the happiness of another."

In this way does our author account for the origin of gratitude; which at last becomes a habit, and flows spontaneously towards every man who has either been or intended to be our benefactor. According to him, it is easy to observe also, that, from associating pleasure with the happiness of an individual when we procure it ourselves, it must of course soon follow, that we should experience pleasure from a view of his happiness any way produced; such happiness raising at all times pleasant ideas when it is presented to our minds. This is another feature of a disinterested affection, to feel delight from the mere increase of happiness in the object whom we love.

"It may be objected, perhaps, that parents seem to have an *instinctive* disinterested love of their offspring; but surely the love of a parent for a new-born infant is not usually equal to that for a child of four or five years old. When a child is first born, the prospect and hopes of future pleasure from it are sufficient to make a parent anxious for its preservation. As the child grows up, the hope of future enjoyment from it must increase: hence would pleasure be associated with the well-being of the child, the love of which would of course become in due time disinterested."

Our author does not analyse *pity*, and trace it to its source in selfishness; but he might easily have done it, and it has been ably done by another author. Pity or compassion is the uneasiness which a man feels at the misery of another. It is generated in every mind during the

the years of childhood; and there are many circumstances in the constitution of children, and in the mode of their education, which make them particularly susceptible of this passion. The very appearance of any kind of misery which they have experienced, or of any signs of distress which they understand, excite in their minds painful feelings, from the remembrance of what they have suffered, and the apprehension of their suffering it again. We have seen a child a year old highly entertained with the noise and struggles made by its elder brother when plunged naked into a vessel filled with cold water. This continued to be the case for many days, till it was thought proper to plunge the younger as well as the elder; after which the daily entertainment was soon at an end. The little creature had not been itself plunged above twice till it ceased to find diversion in its brother's sufferings.—On the third day it cried with all the symptoms of the bitterest anguish upon seeing its brother plunged, though no preparation was then made for plunging itself: but surely this was not disinterested sympathy, but a feeling wholly selfish, excited by the remembrance of what it had suffered itself, and was apprehensive of suffering again. In a short time, however, the painful feelings accompanying the sight of its brother's struggles, and the sound of his cries, were doubtless so associated with that sight and that sound, that the appearance of the latter would have brought the former along with them, even though the child might have been no longer under apprehension of a plunging itself. This association, too, would soon be transferred to every boy in the same circumstances, and to similar sounds and struggles, from whatever cause they might proceed.

Thus, as Dr. Hartley observes, “when several children are educated together, the pains, the denials of pleasure, and the sorrows, which affect one, generally extend to all in some degree, often in an equal one. When their parents, companions, or attendants, are sick or afflicted, it is usual to raise in their minds the nascent ideas of pains and miseries by such words and signs as are suited to their capacities. They also find themselves laid under many restraints, on account of the sickness or affliction of others; and, when these and such like circumstances have raised in their minds desires to remove the causes of their own internal feelings, *i. e.* to ease the miseries of others, a variety of internal feelings and desires become so blended and associated together, as that no part can be distinguished separately from the rest, and the child may properly be said to have compassion. The same sources of compassion remain, though with some alteration, during our whole progress through life. This is so evident, that a reflecting person may plainly discern the constituent parts of his compassion while they are yet the mere internal and, as one may say, selfish feelings above-mentioned; and, before they have put on the nature of compassion, by coalescence with the rest. Agreeably to this method of reasoning, it may be observed, that persons whose nerves are easily irritable, and those who have experienced great trials and afflictions, are in general more disposed to compassion than others; and that we are most apt to pity others in those diseases and calamities which we either have felt or of which we apprehend ourselves to be in danger.”

The origin of patriotism and public spirit is thus traced by Dr. Sayers: “The pleasures which our country affords are numerous

and great. The wish to perpetuate the enjoyment of those pleasures, includes the wish to promote the safety and welfare of our country, without which many of them would be lost. All this is evidently selfish; but, as in the progress of gratitude, it finally becomes disinterested. Pleasant ideas are thus strongly connected with the welfare of our country, after the tie which first bound them together has escaped our notice. The prosperity which was at first desirable as the means of future enjoyment, becomes itself an end; we feel delight in such prosperity, however produced; and we look not beyond this immediate delight. It is thus not difficult to observe in what manner a general and disinterested benevolence takes place in a mind which has already received pleasure from the happiness of a few; the transition is easy towards associating it with *happiness in general*, with the happiness of any being, whether produced by ourselves or by any other cause whatever."

From this reasoning, our author concludes, that all our passions may be traced up to original feelings of regard for ourselves. "Thus (in the forcible language of a learned writer of the same school) does self-love, under the varying appearance of natural affection, domestic relation, and the connections of social habitude, at first work blindly on, obscure and deep, in dirt: but, as it makes its way, it continues rising, till it emerges into light; and then, suddenly expiring, leaves behind it the fairest issue,"—benevolent affection.

Self-love forsook the path it first pursu'd,
And found the private in the public good.

It is impossible but that creatures, capable of pleasant and painful sensations, should love and choose the one, and dislike and avoid the other. No being, who knows what happiness and misery are, can be supposed indifferent to them, without a plain contradiction. Pain is not a *possible* object of desire, nor happiness of *aversion*." To prefer a greater good, though distant, to a less good that is present; or to choose a present evil, in order to avoid a greater future evil—is indeed wise and rational conduct; but to choose evil ultimately, is absolutely impossible. Thus far then must be admitted, that every being, possessed of sense and intellect, necessarily desires his own good as soon as he knows what it is; but, if this knowledge be not innate, neither can the desire. Every human being comes into the world with a capability of knowledge, and of course with a capability of affections, desires, and passions; but it seems not to be conceivable how he can actually love, or hate, or dread, any thing, till he know whether it be good, or ill, or dangerous. If, therefore, we have no innate ideas, we cannot possibly have innate desires or aversions. Those who contend that we have, seem to think, that without them reason would be insufficient, either for the preservation of the individual or the continuation of the species; and some writers have alleged, that, if our affections and passions were the mere result of early associations, they would necessarily be more capricious than we ever find them. But this objection seems to arise from their not rightly understanding the theory of their antagonists. The disciples of Locke and Hartley do not suppose it possible for any man in society to prevent such associations from being formed in his mind as shall necessarily produce desires and aversions; far less do they think it possible to form associations of ideas utterly repugnant, so as to de-

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fire that as good which his senses and intellect have experienced to be evil. Associations are formed by the very same means, and at the very same time, that ideas and notions are impressed upon the mind; but, as pain is never mistaken for pleasure by the senses, so an object, which has given us only pain, is never associated with any thing that makes it desirable. We say an object that has given us only pain, because it is possible to form such an association between life and the loss of a limb, as to make us grateful to the surgeon by whom it was amputated. Associations being formed according to the same laws by which knowledge is acquired, it by no means follows that passions resulting from them should be more capricious than they are found to be; and they certainly are sufficiently capricious to make us suspect that the greater part of them has this origin, rather than that they are all infused into the mind by the immediate agency of the Creator. If man be a being formed with no innate ideas, and with no other instinctive principles of action than what are absolutely necessary to preserve his existence and perpetuate the species, it is easy to perceive why he is placed in this world, as in a state of probation, where he may acquire habits of virtue to fit him for a better. It is likewise easy to perceive why some men are better than others, and why some are the slaves of the most criminal passions. But all this is unintelligible, upon the supposition that the seeds of every passion are innate, and that man is a compound of reason and of instincts so numerous and various as to suit every circumstance in which he can be placed.

If passions, whatever be their origin, operate instantaneously, and if they be formed according to fixed laws, it may be thought a question of very little importance whether they be instinctive or acquired. —If, however, passions be the result of early associations, it is of the utmost consequence that no improper associations be formed in the minds of children, and that none of their unreasonable desires be gratified. Upon this theory it seems indeed to depend almost wholly upon education, whether a child shall become a calm, benevolent, steady, and upright, man; or a passionate, capricious, selfish, miscreant. By teaching him to resent every petty injury, the seeds of irascibility are sown in his mind, and take such root, that before the age of manhood he becomes intolerable to all with whom he must converse. By exciting numberless desires in his youthful mind, and instantly gratifying them, you make him capricious, and impatient of disappointment; and, by representing other children as in any degree inferior to him, you inspire him with the hateful passion of pride. According to the instinctive theory, education can only augment or diminish the strength of passions; according to the other theory, it is the source of by far the greater part of them. On either supposition, parents should watch with solicitude over the actions of their children; but they will surely think themselves obliged to be doubly watchful, if they believe, that through their neglect their children may acquire hateful passions, to which, if properly educated, they might have remained strangers through their whole lives. And let it be remembered, that this solicitude should begin at an early period; because the mind is susceptible of deep associations much sooner than is sometimes imagined. Without this susceptibility, no language could be learned; and therefore a child,

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by the time he learns to speak, may have planted in his mind the seeds of passions, on the just regulation and subordination of which depends in a great measure the happiness of mankind.

OF THE EXTERNAL SIGNS OF EMOTIONS AND PASSIONS.

SO intimately connected are the soul and body, that every agitation in the former produces a visible effect upon the latter. There is, at the same time, a wonderful uniformity in that operation; each class of emotions and passions being invariably attended with an external appearance peculiar to itself. These external appearances, or signs, may not improperly be considered as a natural language, expressing to all beholders emotions and passions as they arise in the heart. Hope, fear, joy, grief, are displayed externally: the character of a man can be read in his face; and beauty, which makes so deep an impression, is known to result, not so much from regular features and a fine complexion, as from good-nature, good-sense, sprightliness, sweetness, or other mental quality, expressed upon the countenance. Though perfect skill in that language be rare, yet what is generally known is sufficient for the ordinary purposes of life. But by what means we come to understand the language, is a point of some intricacy. It cannot be by sight merely; for, upon the most attentive inspection of the human visage, all that can be discerned are, figure, colour, and motion, which, singly or combined, never can represent a passion nor a sentiment: the external sign is indeed visible; but, to understand its meaning, we must be able to connect it with the passion that causes it; an operation far beyond the reach of eye-sight. Where then is the instructor to be found than can unveil this secret connection? If we apply to experience, it is yielded, that from long and diligent observation, we may gather, in some measure, in what manner those we are acquainted with express their passions externally: but with respect to strangers, we are left in the dark; and yet we are not puzzled about the meaning of these external expressions in a stranger, more than in a bosom-companion. Further, had we no other means but experience for understanding the external signs of passion, we could not expect any uniformity, nor any degree of skill, in the bulk of individuals: yet matters are so much better ordered, that the external expressions of passion form a language understood by all, by the young as well as the old, by the ignorant as well as the learned.—We talk of the plain and legible characters of that language; for undoubtedly we are much indebted to experience, in deciphering the dark and more delicate expressions. Where then shall we apply for a solution of this intricate problem, which seems to penetrate deep into human nature? Undoubtedly if the meaning of external signs be not derived to us from sight, not from experience, there is no remaining source whence it can be derived but from nature.

We may then venture to pronounce, with some degree of confidence, that man is provided by nature with a sense or faculty that lays open to him every passion by means of its external expressions. And we cannot entertain any reasonable doubt of this, when we reflect, that the meaning of external signs is not hid even from infants: an infant is remarkably affected with the passions of its nurse expressed on her countenance; a smile cheers it, a frown makes it afraid:

but

but fear cannot be without apprehending danger ; and what danger can the infant apprehend, unless it be sensible that its nurse is angry ? We must therefore admit, that a child can read anger in its nurse's face ; of which it must be sensible intuitively, for it has no other mean of knowledge. We do not affirm, that these particulars are clearly apprehended by the child ; for, to produce clear and distinct perceptions, reflection and experience are requisite : but that even an infant, when afraid, must have some notion of its being in danger, is evident.

That we should be conscious intuitively of a passion from its external expressions, is conformable to the analogy of nature : the knowledge of that language is of too great importance to be left upon experience ; because a foundation so uncertain and precarious, would prove a great obstacle to the formation of societies. Wisely therefore is it ordered, and agreeably to the system of providence, that we should have nature for our instructor.

Such is the philosophy of Lord Kames, to which objections unanswerable may be made. It is part of the instinctive system of metaphysics, which his lordship has carried farther than all who wrote before him, and perhaps farther than all who have succeeded him in this department of science. That a child intuitively reads anger in its nurse's face, is so far from being true, that for some short time after birth it is not terrified by the most menacing gestures. It is indeed absolutely incapable of fear till it has suffered pain ; and, could we constantly caress it with what is called an *angry look*, it would be cheered by that look, and frightened at a smile. It feels, however, the *effects* of anger, and is soon capable of observing the peculiarity of feature with which that passion is usually accompanied ; and these two become in a short time so linked together in its tender mind, that the appearance of the one necessarily suggests to it the reality of the other.

Should it be said that a loud and sudden noise startles a child immediately after birth, and that, therefore, the infant must be instinctively afraid, the fact may be admitted, without any necessity of admitting the inference. The nerves of an infant are commonly very irritable, and the strong impulse on the *auditory* nerves may agitate its whole frame, without inspiring it with the passion of fear. The loud noise is, in all probability, not the sign of approaching danger, but the immediate cause of real pain, from which the infant shrinks, as it would from the prick of a pin, or the scorching of a candle.

Manifold and admirable are the purposes to which the external signs of passion are made subservient by the Author of our nature.

The signs of internal agitation, displayed externally to every spectator, tend to fix the signification of many words. The only effectual means to ascertain the meaning of any doubtful word, is an appeal to the thing it represents : and hence the ambiguity of words expressive of things that are not objects of external sense ; for in that case an appeal is denied. Passion, strictly speaking, is not an object of external sense ; but its external signs are : and, by means of these signs, passions may be appealed to with tolerable accuracy : thus the words that denote our passions, next to those that denote external objects, have the most distinct meaning. Words signifying internal action and the more delicate feelings, are less distinct. This defect, with
regard

regard to internal action, is what chiefly occasions the intricacy of logic : the terms of that science are far from being sufficiently ascertained, even after much care and labour bestowed by an eminent writer ; to whom, however, the world is greatly indebted, for removing a mountain of rubbish, and moulding the subject into a rational and correct form. The same defect is remarkable in criticism, which has for its object the more delicate feelings ; the terms that denote these feelings being not more distinct than those of logic.

Society among individuals is greatly promoted by that universal language. Looks and gestures give direct access to the heart ; and lead us to select, with tolerable accuracy, the persons who are worthy of our confidence. It is surprising how quickly, and for the most part how correctly, we judge of character from external appearance.

After social intercourse is commenced, these external signs, which diffuse through a whole assembly the feelings of each individual, contribute above all other means to improve the social affections. Language, no doubt, is the most comprehensive vehicle from communicating emotions : but in expedition, as well as in power of conviction, it falls short of the signs under consideration ; the involuntary signs especially, which are incapable of deceit. Where the countenance, the tones, the gestures, the actions, join with the words in communicating emotions, these united have a force irresistible. Thus all the pleasant emotions of the human heart, with all the social and virtuous affections, are, by means of these external signs, not only perceived, but felt. By this admirable contrivance, conversation becomes that lively and animating amusement, without which life would at best be insipid : one joyful countenance spreads cheerfulness instantaneously through a multitude of spectators.

Disocial passions, being hurtful by prompting violence and mischief, are noted by the most conspicuous external signs, in order to put us upon our guard : thus anger and revenge, especially when sudden, display themselves on the countenance in legible characters. The external signs, again, of every passion that threatens danger, raise in us the passion of fear : which, frequently operating without reason or reflection, moves us by a sudden impulse to avoid the impending danger.

These external signs are remarkably subservient to morality. A painful passion, being accompanied with a disagreeable external sign, must produce in every spectator a painful emotion : but then, if the passion be social, the emotion it produces is attractive, and connects the spectator with the person who suffers. Disocial passions only are productive of repulsive emotions, involving the spectator's aversion, and frequently his indignation. This artful contrivance makes us cling to the virtuous, and abhor the wicked.

Of all the external signs of passion, those of affliction or distress are the most illustrious with respect to a final cause, and deservedly merit a place of distinction. They are illustrious by the singularity of their contrivance ; and also by inspiring sympathy, a passion to which human society is indebted for its greatest blessing, that of providing relief for the distressed. A subject so interesting deserves a leisurely and attentive examination. The conformity of the nature of man to his external circumstances is in every particular wonderful : his nature makes him prone to society ; and society is necessary

cessary to his well-being, because in a solitary state he is a helpless being, destitute of support, and in his distresses destitute of relief: but mental support, the shining attribute of society, is of too great moment to be left dependent upon cool reason; it is ordered more wisely, and with greater conformity to the analogy of nature, that it should be enforced even instinctively by the passion of sympathy. Here sympathy makes a capital figure; and contributes, more than any other means, to make life easy and comfortable. But, however essential the sympathy of others may be to our well-being, one beforehand would not readily conceive how it could be raised by external signs of distress: for considering the analogy of nature, if these signs be agreeable, they must give birth to a pleasant emotion leading every beholder to be pleased with human woes: if disagreeable, as they undoubtedly are, ought they not naturally to repel the spectator from them, in order to be relieved from pain? Such would be the reasoning beforehand; and such would be the effect were man purely a selfish being. But the benevolence of our nature gives a very different direction to the painful passion of sympathy, and to the desire involved in it: instead of avoiding distress, we fly to it in order to afford relief; and our sympathy cannot be otherwise gratified but by giving all the succour in our power. Thus external signs of distress, though disagreeable, are attractive: and the sympathy they inspire is a powerful cause, impelling us to afford relief even to a stranger, as if he were our friend or relation.

It is a noted observation, that the deepest tragedies are the most crowded: which in an overly view will be thought an unaccountable bias in human nature. Love of novelty, desire of occupation, beauty of action, make us fond of theatrical representations; and, when once engaged, we must follow the story to the conclusion, whatever distress it may create. But we generally become wise by experience; and, when we foresee what pain we shall suffer during the course of the representation, is it not surprising that persons of reflection do not avoid such spectacles altogether? And yet one who has scarcely recovered from the distress of a deep tragedy, resolves coolly and deliberately to go to the very next, without the slightest obstruction from self-love. The whole mystery is explained by a single observation:—That sympathy, though painful, is attractive; and attaches us to an object in distress, instead of prompting us to fly from it. And by this curious mechanism it is, that persons of any degree of sensibility are attracted by affliction still more than by joy.

To conclude: the external signs of passion are a strong indication, that man, by his very constitution, is framed to be open and sincere. A child, in all things obedient to the impulses of nature, hides none of its emotions; the savage and clown, who have no guide but pure nature, expose their hearts to view, by giving way to all the natural signs. And even when men learn to dissemble their sentiments, and when behaviour degenerates into art, there still remain checks, that keep dissimulation within bounds, and prevent a great part of its mischievous effects: the total suppression of the voluntary signs during any vivid passion, begets the utmost uneasiness, which cannot be endured for any considerable time: this operation becomes indeed less painful by habit; but luckily the involuntary signs cannot, by any effort, be suppressed, nor even dissembled. An absolute

hypocrisy, by which the character is concealed and a fictitious one assumed, is made impracticable; and nature has thereby prevented much harm to society. We may pronounce, therefore, that Nature, herself sincere and candid, intends that mankind should preserve the same character, by cultivating simplicity and truth, and banishing every sort of dissimulation that tends to mischief.

ACCOUNT OF THE MONKS OF ST. BERNARD.

THE convent belonging to this religious order is situated on a mountain, at the entrance of the Alps, commanding the passage, which is very narrow, and rendered famous in history, by the ancient inhabitants disputing this very pass with Hannibal, in his march across these mountains to invade Italy.

That elevated spirit of charity, which has multiplied poor-houses, and propagated hospitals all over Christendom, houses of benevolence, such as the Romans, in their highest refinements, so little knew that they have no appropriated word in their language to signify either, proceeding in the same career of humanity, has settled a convent at Martigny, dedicated to St. Bernard, so extending its own appellation to the hill itself, and calculated for the relief of wretched travellers. This has now turned the whole town of the Gauls and Romans into an inn, a hospital, an infirmary, for them. The monks of this convent assist travellers with a care and a cordiality that do infinite honour to the institution and to themselves, that sweep away at once all our Protestant prejudices against monks, and exhibit *these* to us as the most beneficent beings of our race.

There are ordinarily between twenty and thirty monks: eight are usually dispersed among the Alpine parish churches that are under their patronage; and ten or twelve are constantly resident here, being such as, from their age and health, are able to bear the keen atmosphere of the mountain. The few others who can no longer bear it, are permitted to reside with the aged provost of the whole in a house which belongs to the convent, and is situated at Martigny below. The monks of the mountain are employed in a manner of which British protestanism, removed from the sight of such institutions, and naturally warped with its own prejudices, has no conception: in the prosecution of their private studies, in the instruction of their novices, in the education of some scholars who are sent to board and lodge with them, and in managing the temporal œconomy of the whole. They have a prior, the deputy of the provost, and governor of the convent in his absence; a sacristan, who takes care of their chapels, and whom we have equally among ourselves, but have degraded into a mere sexton; a cellarer, serving as purveyor, comptroller of the kitchen, and managing all the exterior concerns of the monastery; a clavandier, who keeps the keys, and dispenses the articles wanted to the monks and to the travellers; and an infirmier, who takes care of the sick in the apartment appropriated to them.—The cellarer keeps twenty horses constantly employed during the summer, in fetching the magazines of flour, bread, cheese, liquors, and dried fruits, for themselves and their guests; or forage for the milch cows, and fattening cattle, during the winter; their fire-wood, of which they expend a very great quantity, is brought
them

them on the backs of mules, from a distance of four leagues, and by a steep path that is practicable only for six months in the whole year. Then, before the winter sets in, they send down their horses for the season to a farm which they have on the northern side of the Rhone.

But it is peculiarly pleasing to a tender mind, to note the useful solicitude of these amiable monks, on such days as the pass is most frequented, in personally receiving, warming, and recovering, travellers that are exhausted by their excess of fatigue, or indisposed from the severity of the air. With equal eagerness they attend their own countrymen and a foreigner. They make no distinction of state, of sex, or of religion; and ask no questions concerning the nation or the creed of the wretched. Their wants or their sufferings are what primarily entitle them to their care. In winter, and in spring, their solicitude has a larger scope of activity, and takes a wider range of attention. From that very time, nearly, in which Hannibal carried an army over Great St. Bernard, and at which the Romans reckoned the general winter of Italy to commence, from the 1st of November through the winter, to the 1st of May, a trusty Alpine servant, who as an Alpine is denominated a *Maronnier*, and one or two dogs of an extraordinary size with him, are constantly engaged in going to meet travellers, a considerable way down the descent toward the Vallais.

These dogs possess an instinct and receive a training, which fit them to be peculiarly useful in their employment. They point out the road to the guide and the travellers, through fogs, tempests, and snows; they have also the sagacity to discover travellers that have wandered out of the way, have floundered in the drifts of snow, and are lying wearied, exhausted, upon them. But, what forms a wonderful addition of kindness, the monks often go themselves with the guide in order to see assistance more promptly administered to the unfortunate, and to act occasionally as friends to the soul equally with the body. Even when the guide is not sufficient of himself to save the unhappy traveller from perishing, they run to his assistance themselves, support him with their own arms, lead him with their own hands, and sometimes carry him up to the convent upon their own shoulders. They are often obliged to use a kind of friendly violence to him, when he is benumbed by the cold or worn out by fatigue. He then insists upon being left to rest, or even to sleep for a moment, upon the snow; the torpid influence of the cold is stealing upon him, renders all motion unpleasant, and is gently carrying the sleep of death from the extremities to the heart. The monks know this; and the very thing which he dislikes, they know to be the only means of saving him. They are therefore compelled to shake the traveller in his deadly doze, and to drag him by force from his fatal bed of slumber. They thus expose themselves to all the severities of the weather, in order to save others. They necessarily suffer much in the work. At times, when the quantity of snow upon the ground prevents them from walking fast, and so their bodies are not properly warmed with their own motion, their extremities would congeal with the cold before they perceived their numbness: they are therefore obliged to carry short thick staves with them armed at the ends with iron, and to strike their hands and feet with them continually.

They even stretch their exertions of humanity beyond all this. About three miles below the convent, on the road of Hannibal's ascent, they have built a small vaulted room, called the hospital. This is intended for the casual refreshment of travellers benumbed and unable to reach the convent. The trusty maronnier visits it frequently, in order to meet the traveller; but goes principally at the approach of night, and on his return leaves some bread, cheese, and wine, behind. This man even sallies out extraordinarily, when a storm is just over, with his stock of wine and meat, takes his way to the building, and assists all that he finds distressed. The monks themselves also may be frequently seen on the tops of their rocks, watching to do offices of humanity. When the new snow is deep on the ground, they appear making roads through it, and preventing fatal accidents by charitable vigilance.

But notwithstanding all these glorious exertions of humanity, upon the hill which Hannibal traversed so late as the beginning of winter and the falling of the snows, scarcely a winter passes in which some traveller is not brought to the convent with his limbs frozen into absolute inactivity.

The traveller is sometimes overwhelmed at once, and plunged into the body of a mountainous snow-ball. When he is not very deep, the dogs discover him by the scent; but when any is missing, whom their sagacity cannot penetrate far enough to discover, the monks engage in a laborious office themselves. They range upon the snow, and sound it with long poles. The resistance, which they feel at the end, tells them decisively, whether it is a rock or a body that they strike. If it is a body, they instantly clear away the snow over it, and bring the person to air and life again. They have been the means of rescuing many, in this way, from the very jaws of death. The amazing sweep of destruction which these globes of snow frequently carry with them, may be sufficiently estimated from one of them that fell upon a party of Swiss soldiers marching over the Alps, and buried no less than sixty of them in its vast bulk. But to be more particular, as particularity is the soul of description to a being formed like man; and to shew the dangers more strikingly to which Hannibal and his men were exposed; I will relate an anecdote of what happened lately, on the very pass over Great St. Bernard. In the year 1781, some travellers attempted to pass the mountain when the snows had fallen. They could not be induced to stay, by the obliging monks, more wary than they concerning the weather, and more experienced about the road. These, finding their efforts to detain them unavailing, ordered their servants to prepare for conducting them along the pass. The travellers, however, without waiting for their guides, took the road from the convent towards Italy, and went along the side of the lake about nine in the morning. In such a road, and in such a season as that, travellers should always keep themselves close to each other, to be more in a state of resistance against the snow-balls, and to be more capable of lending or receiving aid in struggling out of the snows: but this precaution was totally neglected by the travellers in their impatience to push on; and they marched in a file, one after the other, with a considerable interval between some of them. In this disposition, and when they had but just wished each other a happy journey, a snow-ball flew with the rapidity of lightning from one of the pikes on their right, and burst in an instant destruction upon their heads. At the noise
which

which this made, the prior of the convent opened hastily his window, threw his eye in a glance along the road, and, seeing no appearance of the travellers, at once took in the whole calamity. He immediately gave an alarm to the house, the inhabitants all assembled, the long poles were taken in their hands, and they rushed out in a hurry, unchecked by the danger of being lost themselves. What an affecting spectacle does this exhibit to us; men who encounter the greatest difficulties, who fear not even death itself, in order to save the dying. With very great difficulty, these good fathers had the happiness to recover from the snows the greatest part of the travellers. These were carried to the convent, and brought back to life by the care that was taken of them. Three only perished, and their bodies were not found till two months afterward, when the snows melted.

A PICTURESQUE DESCRIPTION OF THE RHINE, FROM
ITS SOURCES IN SWISSERLAND TO ITS ENTRANCE INTO
THE GERMAN OCEAN.

THE celebrated Rhine, the boundary of so many considerable states in Europe, has its sources in the Alps of the country of the Grisons, in Swisserland. It is formed of two principal streams, the Upper Rhine to the east, and the Lower Rhine to the west.

The Upper Rhine, which is also called the Hinder Rhine, issues from one of the greatest glaciers in all Swisserland, in Mount Vogelberg, or the Bird Mountain.

— *Ruunt de montibus amnes.*

VIRG.

Torrents roll roaring down the mountain's sides.

Those from the neighbouring mountain of St. Bernardin rush onward to augment the infant stream, which flows from the village of Splugen to Ander, through a mountainous region, presenting, at every point of view, the most awful magnificence of scenery. It flows hence to Zillis, and, afterward, by the side of the *Via Mala*, a road so called from the supposed difficulties and dangers of passing through it. Such dreadful descriptions have been given of it by different travellers, that every new tourist may expect to find it the worst road he had ever explored. He will, however, be agreeably deceived; for he will not find it more incommodious than the way from Splugen to Ander; nor will he once think it necessary to dismount from his horse, except when he chooses to stop, to take a nearer view of any particular scene. The road even admits of carriages. No reason, therefore, can be imagined, why this particular way should be distinguished by the appellation of *Via Mala*, unless such descriptions allude to former times, and modern writers have adopted them as the mere echos of ancient travellers. Perhaps the peculiar gloom of the valley, through which the road passes, may have contributed to convey these ideas of terror to persons not accustomed to Alpine regions. Indeed, the *Via Mala* runs through a dark and uninhabited valley, overspread in many parts with thick forests, which admit only a kind of twilight gloom, and so exceedingly narrow, that the steep rocks, which inclose it, hang over, and seem almost

almost to meet toward their summits. The Rhine foams at the bottom, sometimes not visible, and sometimes faintly glimmering

Through darksome pines, that, o'er the rocks reclin'd,
Wave high, and murmur to the hollow wind. POPE.

About three miles from the commencement of the *Via Mala* is a stone bridge of a single arch, thrown across a gulph; a sublime scene, which the traveller will stop to admire, and will leave with regret. The river falls in a beautiful cascade, rolls in a narrow channel at the depth of more than four hundred feet perpendicular, furiously dashes under the bridge, expands itself into a wide basin, and then is lost under a rock, through which it has forced a passage. The impending mountains, partly bare and partly embrowned with firs, cast an awful gloom over the gulph below. The traveller will be greatly struck here with a circumstance, which he may have observed, indeed, in other valleys of Switzerland, but no where in such perfection as at this place. The Rhine, which is at present about four hundred feet below the bridge, seems evidently to have once flowed as high, or even higher, than the bridge now stands; to have gradually worn away the rock, and excavated the deep channel in which it now runs. Having passed this bridge, the traveller proceeds through a subterraneous opening, a few paces in length, which had been cut through the over-hanging rock; and, a little farther, he will cross a second bridge, similar to the first. Hence this branch of the Rhine proceeds by *Tüfis* and *Fürstenuau*, and joins the Upper Rhine at *Reichenau*.

To the Lower Rhine two sources are ascribed: the first, called the *Vorder Rhein*, or *Further Rhine*, descends from a glacier on the summit of *Mount Badus*, and forms a piece of water, half a mile in circumference, called the *Lake of St. Thomas*: the second, named the *Middle Rhine*, issues from *Mount St. Barnabas*. They are both insignificant rivulets till their junction below *Disentis*, when the Upper Rhine is not larger than the *Hinder Rhine*. It passes by *Ilants*, the capital of the *Grey League*, flowing through the valley of *Sopra Selva*, in a rapid and shallow stream, which forms repeated cataracts. The valley of *Sopra Selva*, which is the most populous of the *Grey League*, extends from *Mount St. Gothard* to *Reichenau*, where, as before observed, the Upper and Lower Rhine unite.

At *Reichenau* are two curious bridges, built by the nephew of *Ulric Grubenman*, the self-taught architect of the celebrated bridges of *Schaffhausen* and *Wettingen*. The first, which is thrown across the *Hinder Rhine*, measures one hundred and five feet. The second is built across the Rhine, below the point of union, and forms a very beautiful object. It is a wooden bridge, of a single arch, covered like that of *Schaffhausen*; and the span of the arch is two hundred and twenty feet in length.

From *Reichenau*, the Rhine passes within a mile of *Coire*, the capital of the country of the *Grisons*, the environs of which are delightful. The plain, through which the Rhine rapidly flows, is richly diversified with corn and pasture; the hills, gradually sloping to the foot of the mountains, are covered with vines, which yield wine of an agreeable flavour, but not strong. The points of view vary surprisingly, from agreeable to romantic, from romantic to wild. The river begins here to be navigable for rafts, and merchantile

chandise is transported by it toward Lindau and Zurich. After passing by Mayenfeld, Sargans, Werdenberg, and Sax, and forming the boundary between the Rheintal, or Valley of the Rhine, and the circle of Austria, it enters the lake of Constance, below Rheinec, the capital of this valley. This lake is one of the largest in Switzerland, and separates it from Suabia. It is divided into three parts; the upper part, which is the largest, is also called the Bodmer See; that in the middle is named the Bodmer See; and the lower part is denominated the Unter See, the Zeller See, or the lake of Zell. The lake of Constance, including its three divisions, is about twelve leagues in its greatest length, and four in its greatest breadth. On its banks are the towns of Zell, Uberlingen, Merspurg, Buchorn, and Lindau, in Suabia; of Bergens, in the Tirol; and of Roschah and Arbon, in Switzerland. At Merspurg it is three hundred fathoms deep. It is well stored with fish, with which a great trade is carried on; quantities of them being sent pickled as far as Vienna. The vessels employed on this lake are from one hundred and twenty to one hundred and fifty tons burden. Its environs are pleasant and well cultivated, its borders consisting of gently-rising hills. It is surrounded by a number of towns, villages, castles, monasteries, &c. The jurisdiction of this lake belongs partly to the house of Austria; and partly to the eight ancient cantons, sovereigns of Thurgau; and to the abbot of St. Gall. Their limits were determined by a treaty concluded in 1685 with the Emperor Leopold.

Between its outlet at the western extremity of the Bodmer See and its entrance into the eastern extremity of the lake of Zell, the Rhine, on its left bank, forms a delightful situation for the city of Constance, within the limits of Suabia, opposite to which is Peterhausen. A susceptible mind will be much affected with the solitary appearance of a town once so flourishing in commerce and so celebrated in history. A dead stillness reigns throughout; grass grows in the principal streets; in a word, it wears the melancholy aspect of being almost totally deserted; and scarcely contains three thousand inhabitants. It has experienced a melancholy reverse of fortune: supported by the alliance of Zurich and Basle, the inhabitants had expelled their bishop, and embraced the reformation. But the Protestant cantons having been worsted in 1531, and the league of Smalkald, of which Constance was a member, having been defeated by Charles V. the town was obliged to submit to the emperor, and to re-admit the Catholic religion. From this period, it lost its independence; and, being neglected by the house of Austria, fell, by degrees, into its present almost annihilated state; exhibiting to some of the neighbouring Swiss cantons an instructive contrast, which must sensibly endear to them their own invaluable happiness, in the commerce and liberties which they enjoy. Travellers who visit this city are shewn the chamber in which the council of Constance was held in 1415; and they may have the honour of sitting in the two chairs, in which sat Pope John XXIII. and the Emperor Sigismund, if any honour can be derived from a turbulent pontiff and a perjured sovereign. By the sentence of this council, the celebrated reformer, John Hufs, who had embraced the doctrines of our illustrious Wickliffe, was burnt as a heretic, notwithstanding the infamous emperor had granted him a safe conduct. Jerome of Prague, his disciple, had the weakness to recant before the same council; but this weak-

ness.

ness was amply atoned for by the magnanimity with which he retracted this recantation, and the calm intrepidity which he displayed, in his last moments, at the stake.

In 1785, the Emperor Joseph II. invited a colony of emigrant Genevans to settle in this city; and, by the year 1787, seventy families, chiefly watchmakers, had settled here, attracted by the assurances of the free exercise of their religion, and other liberal encouragement. A convent of Dominicans, which had been secularized, was granted to them for the purpose of establishing a manufactory of printed linens and cottons; and the refectory was appropriated for the chapel of the new colony. Mr. Coxe visited this convent in 1787: "I did not omit," says this excellent writer, "visiting a small dungeon, about eight feet long, six broad, and seven high, in which John Hufs was confined, and wherein I observed the very stone to which he was chained. I entered it, however, with very different sensations from those which I experienced in 1776, when this convent was the abode of monkish superstition. It is now the seat of trade and industry; and it must suggest a pleasing reflection to a philosophic mind, that a successor of Sigismund, who violated his word, should have consigned to a reformed establishment that very convent in which the Bohemian divine was imprisoned, and from which he was triumphantly led to the stake; and that the most enlarged principles of toleration should be manifested in the same place where persecution was inculcated by precept and example. It is the triumph of reason and religion over bigotry and intolerance."

Leaving Constance, the Rhine enters the Zeller See, which it leaves near Stein, an independent town, under the protection of Zurich. Travellers seldom fail to visit the island of Reichenau, in this lake. It is about three miles long and one broad; and contains about sixteen hundred inhabitants (all Catholics), three parishes, one village, and a rich Benedictine abbey, of which the Bishop of Constance is abbot. This abbey once counted five hundred gentlemen among its vassals, and its abbot was a prince of the empire. Among the relics in the convent is shewn a curious tooth of Charles le Gros. That monarch, who was emperor and king of France, and who possessed dominions as extensive as those of Charlemagne, lived to want the common necessities of life, and to depend for subsistence upon the charity of an archbishop of Mentz. He was publicly deposed, in 887, at a meeting of the principal French, German, and Italian, barons, whom he himself had summoned. He died, a year after, in extreme want and misery, at a small village near Mentz, and his remains were conveyed to this convent, where his tomb is to be seen.

Hitherto the Rhine had kept a course nearly north-by-east; from Stein it takes a westerly direction to Diessenhoffen and Schaffhausen. At the latter town the Rhine is near four hundred feet wide, and has a curious wooden bridge built by Ulric Grubenhagen, a carpenter of Tuffen, in the canton of Appenzel; a man totally ignorant of the theory of mechanics. The river being extremely rapid here, had already destroyed several stone bridges of the strongest construction, when Grubenhagen offered to throw a wooden bridge of one arch over the river. The magistrates, however, required that it should consist of two arches, and that he should, for that purpose, employ the middle pier of the old bridge. He has done so, but has

contrived to leave it a matter of doubt, whether the bridge is really supported by the middle pier, and whether it would not have been equally as safe if formed of one arch. "It is," says Mr. Coxe, "a wooden bridge, of which the top and sides are covered, and is what the Germans call *hängewerk*, or hanging bridge: the road, which is almost level, is not carried, as usual, over the top of the arch, but, if I may use the expression, is let into the middle of it, and there suspended. The pier is not in a right line with the buttresses, as it forms with them a very obtuse angle pointing down the stream, being eight feet out of the rectilinear direction. The distance of this middle pier from the shore that lies toward the town is one hundred and seventy-one feet, and, from the other side one hundred and ninety-three; in all three hundred and sixty-four; making, in appearance, two arches of surprising width, and forming a beautiful perspective when viewed at some distance. A man of the slightest weight feels it almost tremble under him; yet waggon heavily laden pass over without danger. It has been compared to a tight rope, which trembles when struck, but still preserves its firm and equal tension. I went under this bridge, in order to examine its mechanism, and could not avoid being highly pleased with the simplicity of the architecture. I was not capable of determining whether it rests on the middle pier; but many judges agree that it does not."—Subsequent observations, however, satisfied Mr. Coxe that it did.

Three miles below Schaffhausen, at the village of Lauffen, is a celebrated cataract. A scaffolding is erected in the very spray of this tremendous fall, and upon the most sublime point of view; the sea of foam rushing down; the continual cloud of spray scattered to a great distance, and to a considerable height; the magnificence of the whole scenery, in a word, surpassing the most sanguine expectations, and exceeding all description. Within about one hundred feet of the scaffolding, two crags rise in the middle of the fall. The nearest is perforated by the continual action of the river; and the water forces itself through, in an oblique direction, with inexpressible fury and a hollow sound. "After having contemplated," says Mr. Coxe, "the awful sublimity of this wonderful landscape, we descended, and crossed the river, which was extremely agitated. Hitherto I had only viewed the cataract obliquely; but here it opened by degrees, and displayed another picture, which I enjoyed at my leisure, as I sat down upon the opposite bank. The most striking objects were the castle of Lauffen, erected upon the very edge of the precipice, and projecting over the river; near it, a church and some cottages; a clump of cottages close to the fall; in the back ground, rocks, planted with vines, or tufted with hanging woods; a beautiful little hamlet upon the summit, skirted with trees; the great body of water, that seemed to rush out from the bottom of the rocks; the two crags above-mentioned boldly advancing their heads in the midst of the fall, and in the very point of its steepest descent, their tops sprinkled with shrubs, and divided the cataract into three principal branches. The colour of the Rhine is extremely beautiful, being of a clear sea-green; and I could not but remark the fine effect of the tints, when blended with the white foam in its descent. There is a pleasing view from an iron-foundry close to the river, which is dammed up, in order to

prevent its carrying away the works and neighbouring cottages. By means of this dam, a small portion of the river is diverted, turns a mill, and forms a little silver current, gliding down the bare rock, and detached from the main cataract. Below the fall, the river widens considerably into a more ample basin: at the fall the breadth seems to be about three hundred feet. As to its perpendicular height, travellers differ: those who are given to exaggeration reckon it one hundred feet; but I should imagine fifty or sixty feet will be nearer the truth."

From Lauffen, the Rhine takes a southerly direction, and, soon after, forms the island of Rheinau, in which is a town of the same name, with a convent of Benedictines. Thence it takes a direction, nearly west, to Eglisau, in the canton of Zurich, below which it begins to be the boundary between Swisserland and Suabia. It then visits Kayserstul, Zurzac, and Coblentz; all very ancient towns in the county of Baden. Zurzac is celebrated for two annual fairs, much resorted to by the merchants of Germany and France; and Coblentz is a very important place, on account of its situation in the angle formed by the junction of the Rhine with the Aar. The latter river, having been considerably augmented by the tribute of waters from the Reufs and the Limmat, here vies, in size and rapidity, with the great river in which it loses its name. Its banks are agreeably enlivened by meadows and woods, and spotted occasionally with villages, castles, and ruins, hanging on the water's edge. Having made a small turn, it falls, by a strait channel, into the Rhine. Its waters, which are of a silvery hue, are, for a long way, distinguished from those of the Rhine, which, being transparent, and of a sea-green colour, seem to disdain the union. The banks of the Rhine are far superior, in wildness and beauty, to those of the Aar; in many parts, rising perpendicularly, yet feathered with wood; in others, sloping in gentle declivities, richly bordered with vines, forests, and pastures; and exhibiting a continual succession of towns and villages. Passengers, who are carried in boats down the rapid stream, at the rate of six miles an hour, disembark at Lauffenburg, one of the four forest towns of Suabia, seated on a rock, and divided into two parts by the river, which here forms a small cataract. Though this is greatly inferior to the fall at Lauffen, it deserves to be visited by travellers, for the beauty, of the scenery. The view from the crags of the northern shore are very picturesque: the principal objects are, a high bridge, partly open and partly covered, supported by three lofty stone piers, on the south a row of houses, with an old ruined castle on the summit, boldly overhanging the water; a perspective of woods and meadows under the arches of the bridge; and the river dashing over its craggy bed, in a sloping cataract, until it loses itself suddenly among the rocks which close the view.

Half a mile below this fall is the place of re-embarkation, and the stream pursues its course, by Seckingen and Rheinfelden, (each of them one of the four forest towns in Suabia,) to Basle. Seckingen is seated on an island formed by the river, the waters of which, near Rheinfelden, rush with such increasing velocity, that they are agitated like the waves of the sea, and, beating against the boats, have been known to turn them obliquely by their violence. In many parts, and for a considerable way, these vessels are driven within a

few

few inches of the shelving rocks, and are prevented from striking against them only by the dexterity of the pilot. In a word, the passenger is hurried along with such rapidity, that he has no time for observation, much less for description: he can only catch a general glance of the romantic scenery, as the vessel passes under a picturesque bridge of several arches, suspended above the surface of the river, and joined to a steep rock, on which tower some majestic ruins remain. On approaching Basle, however, the stream becomes gradually less rapid.

At Basle, or Basil, the Rhine turns directly to the north. It is here a broad, deep, and rapid, stream. Basle is the capital of the Swiss canton of the same name. It is the largest city in Switzerland, and is beautifully situated on both sides of the river. The ancient or great city is on the western or Swiss side of the river; the small city on the eastern or German side: both are united by a bridge, six hundred feet long, and surrounded by walls and ditches. In the environs of the great city are five large suburbs, which are likewise inclosed by fortifications. The little river Birsig crosses the great city, and the Birs, which falls into the Rhine, above Basle, supplies it, by means of a canal, with water for various uses.

The cathedral is an elegant gothic structure, but strangely disfigured by a daubing of rose-coloured paint spread over the whole edifice. What is most worthy of attention in it is the marble tomb under which are deposited the great and venerable Erasmus; a writer, who, to superior learning, and a peculiar elegance of style, united the keenest wit, which he pointed, not only against the vices and ignorance of the monks, but the general corruptions and disorders of the Romish church; and yet, such was the moderation or the timidity of this great man, that to this very church he zealously inculcated submissive obedience. But, whatever imperfections may be discovered in this illustrious character, his memory must be revered by every friend of genius, learning, and moderation. Liveliness of imagination, depth and variety of erudition, with great sagacity of judgment, were in him eminently united. He infused a spirit of elegance even into theological controversies, and contributed to disincumber literature from that scholastic jargon with which it was disgraced.

Erasmus, who was a native of Rotterdam, reflected much honour upon this city, by choosing it as the favourite place of his residence, and publishing here the greatest part of his valuable works. He died in 1536, at the age of sixty-eight.

The university of Basle, which was founded in 1459, by Pope Pius II. is the only one in Switzerland. It has a rich library, a botanical garden, and a collection of instruments for philosophical experiments. If it be not frequented now so much as some other universities, it may boast of having enrolled among its members a great number of illustrious names; such as Oecolampadius, Amerbach, the Baukins, Grynæus, Buxtorf, Wettstein, Iselin, the Bernovillis, and Euler. Learning, however, is not confined to the university: in general, the sons of the burghers, or citizens, receive an excellent education: they always learn Latin; and it is far from being uncommon, even for the lower sort of tradesmen, to employ their leisure hours in the perusal of Horace, Virgil, and Petrarch.

Three miles to the south-east of Basle, where the little river Er-

getz falls into the Rhine, is the village of Augst, a spot which has furnished more antiquities and medals than any other in Switzerland. It was the ancient Roman colony called Augusta Rauraca, or Augusta Rauracorum, and was destroyed by Attila king of the Huns, so well known by the appellation of the Scourge of God. The few inhabitants that escaped from this savage conqueror joined with those of Basilea or Basilia, to restore this city, which had been likewise ruined by the same barbarians. The new city, which was called, in the middle age, Basula and Basil, soon became, from its advantageous situation, and the fertility of the surrounding country, as populous and flourishing as those times of ignorance and oppression would permit it. In process of time it became subject to the Emperors of Germany. The period is well known, when the imperial authority was absorbed by the usurpations of the great vassals, in whose hands all the benefices of the state became hereditary fiefs, which retained nothing of the first title but an empty ceremony of homage, and certain conditions of tenure, always ill observed, and often openly refused. The bishops, by their address, acquired the same prerogatives; by opposing to the ferocious ambition of these nobles, become too independent, the terrors of a thundering religion, and the tempting bait of absolution; two modes of influence whose effect upon men will ever be in proportion to their ignorance. The ecclesiastics were enriched by their spoils, and soon balanced the power of the greatest barons by the preference which the people gave to the domination of the clergy, which was not only milder and more peaceful, but, by the aid of religion, much better respected. When the bishops of the Rauraci, therefore, transferred the episcopal see to Basil, they assumed the sovereignty of it, under the protection of the Emperor of Germany, their lord paramount. Thus, all the considerable cities of Germany and Switzerland were indebted, almost entirely, to an episcopal see, or to some foundation of an abbey or chapter, for protection and tranquillity, and, consequently for aggrandizement. The riches of these houses attracted the artisans; and the ecclesiastical immunities extending to all the settlers, favoured not a little that industry, which had been disturbed by the general anarchy and private wars, which had so long desolated all the great estates of Europe. Moreover, the inferior nobility of the neighbourhood having found an asylum from the tyranny of the great barons, in the cities, where they united to form a distinct body, they occupied, at first, all the public offices of police and justice in these rising aristocracies. The citizens, properly speaking, exercised the mechanic arts, and respected the administration of the men of family, whom they considered and acknowledged as the defenders of the community.

The bishops of Basle were gradually deprived of their prerogatives, and, in 1501, finally quitted the town, when the canton joined the Helvetic confederacy. The bishops retired, at first, to Friburg, in Brisgaw, and afterwards fixed their residence at Porentru. Upon the introduction of the reformation, in 1525, the constitution of Basle was, in some measure, changed, and the power of the aristocracy limited; and, at present, among the different species of republican governments into which Switzerland is divided, there is not one more singular than that of Basle. To view the general outlines of the constitution, it has the appearance of an absolute aristocracy;

cracy; but, had we room to consider it in detail, it would be found to incline to a democracy.

The Bishop of Basle still retains his title, and this territories are not insignificant. They constitute what is called the *bishopric* of Basle, in contradistinction to the *canton* of Basle. As part of the bishopric is in Germany, in the circle of the Upper Rhine, its sovereign, the bishop, is a prince of the empire; but, from his relations with the Swiss cantons, (to the diets of which, however, he sends no deputy,) we may consider him, in some respects, as a member of the Helvetic body. His territory is bounded on the north, by the district of Sundgau Proper, Alsace; on the west, by Franche Comté; on the south and east, by the cantons of Bern, Soleure, and Basle. It is about sixty miles long by forty broad; beginning at the lake of Biemme, and extending across Mount Jura, almost to the gates of the city of Basle. It contains six towns, thirty-seven castles, and one hundred and seventy villages. It is a very interesting country for a naturalist: it is extremely rich in petrefactions; and here we may find, in miniature, all the singular objects which the Alps exhibit. The canton of Basle is far from being so considerable as the bishopric. It is bounded on the east, by the Frickthal; on the south, by the canton of Soleure; on the west, by the same canton and the bishopric of Basle; and, on the north, by the Alsace and Suabia: extending about twenty-four miles from north to south, and twenty-one from east to west.

The population of the city of Basle seems to have been formerly much greater than it is at present: its extent makes it capable of containing above 100,000 inhabitants, but it scarcely numbers more than 12,000. This decline may be attributed to the narrow policy which actuates the citizens, who are so jealous of the rights of burghership, and value themselves so much on the privileges annexed to it, that they seldom deign to confer it upon foreigners; and as this place, in common with all great cities, experiences a gradual waste of people, by the number of burials exceeding that of births, unless this unequal proportion is compensated by a constant succession of new inhabitants, in process of time every great town must become depopulated; for a supply, to balance this waste, can never be derived from an influx of strangers, where they are not permitted to carry on commerce, or to follow any trade. A few years ago, some of the magistrates, sensible of the impolicy of this unlimited prohibition, procured a law by which the freedom of the town, and the right of burghership, was allowed to be conferred upon strangers; but it was clogged with so many restrictions as by no means to answer the purpose for which it was intended. In other respects, as Basle stands very favourably for commerce, the inhabitants have not neglected this advantage; for they have established a great variety of manufactures, particularly of ribbands and cottons; and an extensive trade is carried on by the merchants.

Of Basle it is remarkable, that all the clocks in the town go an hour too fast. There are various accounts of this extraordinary circumstance: the most popular one is, that, about four hundred years ago, the city was threatened with an assault by surprise. The attack was to be made when the large clock of the tower, at one end of the bridge, should strike one after midnight. The artist, who had the care of the clock, being informed that this was the expected signal,

nal, altered the clock, and it struck two instead of one; so that the enemy, thinking they had been an hour too late, gave up the attempt. As a confirmation of this account, a head is shewn, which is placed near this clock, with its face turned to the road by which the enemy were to have entered; and this head is contrived to loll its tongue out every minute, as if in derision of the plot. But there is another reason for this strange custom, which Mr. Coxe thinks the most probable. "It is well known," says he, "that the choirs of cathedrals are constructed toward the east: that of Basle declines somewhat from this direction, and the sun-dial, which is placed on the outside of the choir, and by which the town-clock is always regulated, partakes of this declination; a circumstance which, according to the celebrated Bernouille, occasions a variation from the true time of above forty-five minutes. The inhabitants of Basle are still so strongly attached to this whimsical custom, that, although it has been often proposed, in the sovereign council, to regulate their clocks properly, the motion has been invariably rejected; and the people would suspect that their liberties were invaded, if their clocks were to agree with those of the rest of Europe."

Below Basle our noble river leaves Swisserland and its mountainous regions, where the curious naturalist, and the moral philosopher, may find inexhaustible subjects of contemplation.

The Rhine now divides Alsace from Suabia; and the first place its waters is the fortress of Huninguen, which is situated in the district of Sundgau, in that part of Alsace, which the French, since the revolution, have named the department of the Upper Rhine, as they have that of the Lower Rhine to Lower Alsace.

The Rhine, which thus serves as a frontier to Alsace on the east, frequently causes terrible devastations, not only in winter, but in the midst of summer, when the snow melts on the Alps. Its inundations then ruin the fields, by covering them with sand. The violent torrents of the river, which generally happen every year, frequently alter the situation of its islands. In this river are found particles of gold which the torrents wash from the Alps; but it is only below Basle that the sand contains this precious mixture, which, in autumn and winter, when the river is at the lowest, is drawn out with the sand, and passing through several waters the gold is extracted. The particles of this metal are seldom so large as a grain of millet. The gold, indeed, is very fine and beautiful; but it is so scarce, that the city of Strasburg, which has the privilege of gathering gold for the length of four-thousand paces, scarcely collects five ounces in a year. The river also contains many chrystals, and particularly pebbles, that receive a beautiful polish, and are much used in France, under the name of Rhine pebbles.

From Huninguen the river flows to Old and New Brisach. The former is a town of Suabia, once the capital of the Brisgaw. It was taken by the French in 1638 and 1703, but was restored each time to the house of Austria. It has a bridge of boats over the Rhine, to New Brisach, a handsome town of Alsace about a mile from the river. It was built by the French, and fortified by Vauban. Fort Mortier, which belongs to it, is seated close to the Rhine, which flows hence, without meeting with any place of consequence, for twenty-five miles, when it visits the celebrated city of Strasburg, the capital of all Alsace, or the two French departments of

of the Upper and Lower Rhine. Nothing can form a finer contrast to the mountains of Swisserland than the plains of Alsace. From Basle to Strasburg, the country is a well-cultivated plain, almost as flat as a bowling-green. Great quantities of tobacco are to be seen hanging at the peasants' doors, this herb being plentifully cultivated in these fields.

Strasburg is an ancient city, commercial, rich, and beautiful. It is seated at the distance of a quarter of a league from the Rhine, a canal from which forms several others in the city, which is crossed, moreover, by the river Ill. Two stone and four wooden bridges form communications between the different wards of the city. The inhabitants are computed at forty-six thousand, exclusive of the garrison. The principal structures are built of a red stone, dug from quarries on the banks of the Rhine. This city, once imperial, was taken by Louis XIV. in 1682. The citadel and other fortifications which that monarch erected here have been so much improved, that Strasburg is considered as one of the strongest places in Europe. It was confirmed to the French by the treaty of Ryswick in 1697. It is entered by six gates. The streets, in general, are narrow; but the principal street, and two others, are broad, regular, and handsome. Before the revolution, Strasburg was an archiepiscopal see; but it has since been degraded into a bishopric, suffragan to Besançon. Whatever may be the fate of episcopacy in France, this prelate, by virtue of the two districts which he holds, as a temporal lord, on the other side of the Rhine, is still a prince of the empire, and has a seat and voice in the diet. In the cathedral is a clock, which shews the motions of the constellations, the revolutions of the sun and moon, the days of the week, the hours, &c. When this clock was first constructed, it was deemed a masterpiece of mechanism and astronomy; but, by modern artists, it is beheld with indifference. One circumstance, however, is very remarkable: it has been found impossible, at any expence whatever, to restore such of the movements as have stopped. Another remarkable object is the pyramidal tower, which is pierced through, and pinked, like lace-work. It is five hundred and forty-nine feet high, and is ascended by six hundred and thirty-five steps. On the whole, the cathedral of Strasburg is a very fine building, and never fails to attract the attention of strangers. "No species of architecture," says Dr. Moore, "is better contrived for the dwelling of heavenly pensive contemplation than the Gothic. It has a powerful tendency to fill the mind with sublime, solemn, and religious, sentiments: the antiquity of the Gothic churches contributes to increase that veneration which their form and size inspire. We naturally feel a respect for a fabric into which we know that forefathers have entered with reverence, and which has stood the assaults of many centuries, and of a thousand storms."—From the pen of Dr. Moore, these reflections deserve attention; for they are serious, and even sentimental: perhaps, however, they will not command implicit acquiescence: perhaps, the awful sensations which a Gothic structure excites, may result more from the consecration of poetry than the consecration of religion.

But what, on a retrospect of those remote ages, when our ancestors entered these temples with reverence, should "fill the mind with sublime, solemn, and religious sentiments?" What was the piety, what the devotion, of these ancestors? It was a piety and devotion

devotion compatible with the most degrading ideas of moral worth, and with a perpetual violation of the laws of virtue. Religion, or rather superstition under that heavenly name, "lifted up her mitred front in courts," and, forgetful that her divine Master had declared his kingdom not to be of this world, was employed, with unholy ambition, in the incessant accumulation of its riches and honours. The recollection of times, when every custom and opinion that can degrade humanity were to be found; when the most cruel tyranny and the grossest superstition reigned without controul; when men seemed to have lost, not only the light of learning, but of their common reasoning; in a word, when even the clergy were so profligate, as publicly to sell absolutions, at certain fixed rates, for the most atrocious crimes; should rather excite the pleasing sensations of contrast, and fill the mind with joy and gratitude, that we now live in times, in which the nature and necessity of moral excellence are so well understood, and in which the essential constituents of true piety are universally allowed to be uniform rectitude in the sight of God, an unaffected purity of life and manners, and an extensive benevolence to our fellow-creatures. The sight of a Gothic cathedral has, therefore, the same effect upon me, in a religious view, as the prospect of an ancient castle has in a political light. We behold the residence of some ferocious baron, whose turbulence had spread desolation and misery around; we recollect the horrors of feudal despotism; and, instead of venerating the memory of the titled savages of those times, we feel here too the cheering and soul-ennobling sentiments of joy and gratitude, in contrasting those gloomy ages with the present enlightened period, when the blessings of liberty also are so well understood and so uniformly enjoyed.

The last place in Alsace, bordering on the Rhine, is the strong fortress of Haguenau, seated on the river Motter, which divides it into two parts. It was formerly a free imperial city; but the French became masters of it in 1673. The great Montecuculi besieged it, in vain, in 1675, but, in the subsequent wars, it was more than once taken and retaken.

Lower down, in Suabia, is Rastadt, a regularly-built and elegant city, the capital of the margravate of Baden-Baden. It has a stately palace, which was formerly adorned with a great number of paintings; but they were considerably diminished by Father Meyer, who had such influence over the margravine dowager, as to cause pictures to the value of fifty thousand guilders, which he judged to be too much in the style of our Thomson's *Musidora*, to be committed to the flames. If their subjects were as inoffensive as the tale of *Musidora* by the most chaste and delicate of poets, the good father, perhaps, carried his refinements too far. At least, there is some truth in a French maxim, "*C'est l'intention des figures d'un tableau, & non pas les nudités, qui forment l'indécence d'une peinture.*"—This town is celebrated for the treaty of peace concluded in 1714, between the emperor and France.

About eight miles farther is the elegant city of Carlsruhe, a name which signifies Charles' Rest. It is seated in a fertile district along the banks of the Rhine, in the margravate of Baden-Durloch, and was built, at the commencement of the present century, by the Margrave Charles William, on a very regular plan. It consists of one principal street of an English mile in length. This street is at a considerable

considerable distance in front of the palace, and in a direction parallel with it. All the other streets go off at different angles from the principal one, in such a manner, that whichever of them you enter, walking from it, the view is terminated by the front of the palace. The length of these smaller streets is ascertained, none of them being allowed to encroach on the spacious area which is kept clear before the palace; but the principal street may be extended to any length; and as many additional streets as they please may be built from it, all of which, according to this plan, will have the palace for a termination. The houses are all as uniform as the streets, being of an equal size and height; so that one would be led to imagine, that not one of the inhabitants is in any considerable degree richer or poorer than his neighbour. There is, indeed, a few new houses more elegant than the others, belonging to some of the officers of the court, built at one side of the palace; but they are not, properly speaking, in the town. The margrave incessantly endeavours to introduce industry and manufactures among his people. There is a considerable number of English tradesmen, who make Birmingham work, and instruct the inhabitants in that business; and, at the time of the great emigrations from Geneva, he engaged many watch-makers from that city to settle here, by granting them encouragements and privileges of every kind. In fine, he allows no opportunity to pass unimproved, by which he can promote the comfort and happiness of his people. A prince of such a character is certainly a public blessing; and, although he is an absolute sovereign, the people are fortunate who are born under his government: but far more fortunate they who live under a government which can protect them independently of the virtues, and in spite of the vices, of their sovereign.

The Rhine, after leaving Carlsruhe, enters the German circle of the Upper Rhine, in which the first considerable place it waters is Philipsburg. This town, which is seated in a morass, is deemed one of the bulwarks of the empire. It is subject to the Prince Bishop of Spire, but its fortifications belong to the empire, in the same manner as Bergen-op-zoom is subject to the elector palatine of the Rhine, as marquis of that town and district, while its almost impregnable fortifications belong to the Dutch. Philipsburg has undergone some severe sieges, particularly that in 1734, when the celebrated Duke of Berwick, natural son to king James II. was killed by a cannon-ball, between his two grandsons, as he was taking a view of the trenches. This great man was one of the most illustrious generals that ever commanded the French armies. He was born in 1671, at Moulins, in France, where his mother, Arabella Churchill, then was, on her return from the waters of Bourbon. He was a soldier from his earliest youth: he was wounded at the siege of Buda, in 1686, and was distinguished in the signal victory, which, about the same time, the Imperialists obtained over the Turks. When his father abdicated the throne, he accompanied him to France. In the war which ensued in Ireland, he signalized himself at the siege of Londonderry, and, at the battle of the Boyne, had a horse killed under him. In 1703, Louis XIV. appointed him to the chief command of the forces sent to support the claim of his grandson, Philip V. to the throne of Spain. In a single campaign, he reduced a great number of important towns and fortresses. He

was recalled to take the command of the troops sent against the insurgents of the Cevennes, whom he effectually subdued. In 1705, he reduced the country and town of Nice, for which, in the following year, he was elevated to the dignity of marshal of France. Having resumed the chief command in Spain, he obtained the great victory of Almanza, which secured to King Philip the contested throne. It is remarkable, that in this battle the victorious French and Spanish army was commanded by an Englishman, and the vanquished confederates by the Earl of Galway, a Frenchman. He reduced Barcelona in 1714; and, for his eminent services, was created Duke of Leria and Xerica in the kingdom of Valencia, a grandee of Spain of the first class, and generalissimo of the Spanish forces. His great military talents lay dormant till the year 1733, when, on the death of Augustus II. king of Poland, and the disputed succession which ensued, he was appointed to the command of the French forces in Germany, and, after having reduced the important fortrefs of Khel, he undertook the siege of Philippsburg, in which he terminated his career of military glory.—This place, however, was taken by the French, about a month afterward, but was restored the following year.

Seven miles north of Philippsburg is the city of Spire, the capital of a sovereign bishopric in the circle of the Upper Rhine. It is seated on the west side of the river, in a delightful plain, where it receives the small river Spirebach. This city was burnt in 1689, by the order of the Louis XIV. The cathedral, which was likewise destroyed in the undistinguishing conflagration, contained the superb monuments of eight emperors and three empresses. These were broken to pieces by the French, who likewise opened and pillaged the imperial vaults, and scattered abroad the bones of the illustrious dead. Louis did not foresee that, a century afterward, his own tomb and ashes, with those of his ancestors and descendants, in the magnificent church of St. Denys, would be treated by the French themselves with no less indignity.—In consequence of the destruction of Spire, the imperial chamber was removed to Wetzlar, where it has continued ever since. Spire, at present, is again under the dominion of the French, with all the places of empire, on the west side of the Rhine, Mentz alone excepted.

Six miles north of Spire is Mannheim, the second city in the palatinate of the Rhine, and the residence of the elector palatine. It is one of the most beautiful cities in Germany, the streets, which are as straight as a line, intersecting each other at right angles. The inhabitants are computed at twenty-four thousand, including the garrison, which consists of five thousand. The fortifications are good; and the town acquires additional strength from being almost surrounded by the Rhine and the Neckar, and situated in a flat, not commanded by any rising ground. The electoral palace is a magnificent structure; and the cabinet of natural curiosities and the collection of pictures are much vaunted. From this palace, in 1674, the elector beheld the dreadful conflagrations in the palatinate, no less than two cities, and five-and-twenty towns, in flames, while lust and rapine walked hand-in-hand with fire and sword. Such were the orders of Louis XIV. too literally executed by Turenne, the ever-infamous hero of the age. The barbarous policy of the royal savage, which can never be held in too much detestation, was repeated in 1689. Men, women, and children;

children, were then driven from their habitations in a severe season, to wander about the fields, and to perish with hunger and cold; while they beheld their houses reduced to ashes, their goods seized, and the possessions pillaged by the rapacious soldiery. This terrible execution began at Manheim, where not only the palaces of the electors were razed to the ground, but their very tombs were opened in search of hidden treasures, and their venerable dust scattered in the air. The flames lighted by Turenne, however dreadful, were like so many torches, compared to the present frightful conflagration, which filled all Europe with horror. And yet, in 1693, were these dreadful scenes of cruelty and barbarity repeated. The French General Chamilly, having taken Heidelberg by storm, put the soldiers and citizens promiscuously to the sword; and, when the massacre ended, rapine began. The houses were burnt, the churches pillaged, the inhabitants stripped, and the persons of the women exposed to violation, without respect to age or condition. It is no wonder, then, that the particulars of these dreadful scenes have been transmitted from father to son, and are still spoken of with horror by the peasantry of the palatinate, among whom the French nation is held in detestation to this day.

About fourteen miles north of Manheim, we pass near Frankendahl, a strong town in the palatinate, remarkable only for having been taken by the Spaniards in 1623, by the Swedes in 1632, and by the French in 1689, when it was burnt to the ground. Seven miles farther, in the circle of the Upper Rhine, but within the limits of the palatinate, is the imperial city of Worms, the capital of a bishopric of the same name, whose bishop is a prince of the empire. This place is celebrated for the diet held here in 1521, when the illustrious Luther appeared to justify his opinions before the emperor Charles V. and the princes and prelates of the empire. When his friends would have dissuaded him from appearing at Worms, by urging the example of John Huss and Jerome of Prague, who were burnt at Constance, notwithstanding the safe-conduct granted them by the perjured Sigismund, he answered, with an intrepidity that marked his character, "I am lawfully called to appear in that city, and thither I will go, in the name of the Lord, though as many devils as there are tiles on the houses were there combined against me." To the honour of Charles, bigot as he was, he did not imitate the conduct of his predecessor.—Among the curiosities in this city, is a picture, over a moveable altar, near the entrance of St. Martin's church, which, from the oddness of the conceit, and the low and profane idea of the painter, has not escaped the notice of travellers. At one of the corners on the top of it, is represented the Omnipotent, "whom the heaven of heavens cannot contain," in the form of an old man, addressing himself to the Virgin Mary, who is placed on her knees in the midst of the picture, holding the infant Jesus by the feet, and ridiculously putting the head of the Redeemer of the World into the hopper of a mill, which is turned by the twelve apostles, by the help of a wheel, while the pope is upon his knees, receiving the hosts that fall from the mill into a golden chalice, one of which he presents to a cardinal, who gives it to a bishop; the bishop presents it to a priest, and the priest gives it to a layman.—The painter, however absurd, was, perhaps, devoutly serious. In these times, however, he would, no doubt, be thought

to have exhibited an admirable satire against the absurd doctrine of transubstantiation; a doctrine, which, with the other corruptions of the church of Rome, has contributed to form so many infidels on the continent, among the *soi-disant* philosophers who adopt opinions without inquiry, and, instead of examining the evidence of Christianity, its pretensions to divine authority, its genuine doctrines, and its glorious views, reject it altogether, on account of the wretched absurdities by which, in the darkest ages, a series of wicked and ambitious men have obscured its native lustre, and sullied its intrinsic excellence.

Twenty miles north-west of Worms is the city of Mentz, the capital of the archbishopric and electorate of the same name, in the circle of the Lower Rhine. Here we have the pleasure of meeting, for the first time, with an agreeable companion, another admirer of the Rhine, for the remainder of our voyage down this noble river; one who is, by turns, lively, arch, and satirical; serious, philosophical, and moral; yet ever engaging, pleasing, and instructive. Many of our readers, perhaps, will recollect the name of Dr. Cogan, who has lately published his account of the Rhine, terminating at Mentz, and to whose interesting narration we shall, therefore, have frequently to refer.

Mentz is finely situated on the west side of the Rhine, below its confluence with the Maine, at the angle formed by which is one of the fortified suburbs, named Gustavusburg; and, on the side opposite the city, connected with it by a bridge of boats, is the strong town of Cassel. Mentz claims the invention of printing, but its pretensions are disputed by Strasburg and Harlem. Dr. Cogan, in an ingenious dissertation, has stated their respective claims, and decided in favour of the latter. The French took Mentz, by surprise, on the 21st of October 1792. They greatly strengthened the fortifications, and placed such a strong garrison in it, that, the next year, it stood a long and severe blockade and siege against the King of Prussia, to whom, however, it surrendered, at last, on the 23d of July 1793. Many of the churches, public buildings, and private houses, were destroyed, or greatly injured, during the siege, as well as the electoral country palace, and some fine villages, vineyards, and country houses. The French, in their turn, have, for some time, blockaded this city; but their operations seem suspended, for the present, in consequence of the treaty of peace which they have recently concluded with his Prussian majesty.

From Mentz, the Rhine pursues a westerly direction. Its whole course, in this part of the country, is very picturesque; the voyager being perpetually amused with a great variety of objects. Pleasant and well-inhabited towns and villages; corn-fields, vineyards, and orchards; castles and religious houses; country-seats and cottages; are intermixed in agreeable confusion; and the broader surface of the river is beautified with islands of various extent. Advancing, however, the richness of the prospect appears mostly on the northern borders, many parts of the opposite shore being flat, sandy, and barren. Near Elfeld, the country assumes a bolder aspect, particularly on the northern shore. The mountains arrange themselves by the side of the Rhine, which continues to keep its course toward the west. Ceres and Pomona here yield the territory to Bacchus. Elfeld is the principal town of the Rheingau, which signifies the district

district of the Rhine: its soil is chiefly devoted to the cultivation of the vine. The country on the eastern side of the hills is covered with a vast forest, named *Landes-wald*, or the Land's forest. Dr. Cogan's animated description of the remainder of his voyage till his arrival at Bingen, must be highly gratifying as a future companion in the boat. Indeed, two volumes in octavo will afford room to expatiate with an interesting minuteness, which the limits of our miscellany will not allow us to indulge.

We have observed, that, from Mentz to Bingen, the *right* side of the Rhine excelled in the bounties of nature. At Bingen the *left* shore assumes a more pleasing aspect: it even exceeds the other, for a great extent, in the number of large and respectable towns; nor is it inferior either in beauty or fertility.

At Bingen, a narrow defile of perpendicular rocks compels the Rhine to flow in a contracted and deeper channel. The country, in the southern direction, though mountainous, is open, and occasionally enlivened with hamlets, and the remains of ancient buildings; and, where the soil is not adapted to the culture of the vine, it is clothed with various sorts of grain, with rich pasturage, or with the trees of the forest.

Bingen is situated at the foot of a lofty mountain of a pyramidal form, close by the rocks above mentioned. On the summit of this mountain, the ancient castle of Klopp assumes the air of guardian to the inhabitants below. The town enjoys a view of the luxuriant scenes that embellish the northern borders. It is also adjacent to the river Nahe, which flows into the Rhine south of the antique castle: over this is thrown a stone bridge contiguous to the Rhine. This bridge bears the name of *Drusus*, from the tradition that it was built by Drusus Germanicus. At the entrance of that part of the Rhine, which flows between the perpendicular rocks, on a small island, is a turret, which has the singular name of *Maus Thurm*, the Tower of Mice. Tradition accounts for this name by the story of Archbishop Hatton the Second, who, it is said, not only refused to distribute corn among the populace during a famine, but ordered a number of the poor to be burnt in a barn, as the most expeditious method of diminishing the demand; observing, that they were no other than *mice* that devoured the property of the rich; and, for this cruelty he was completely devoured by mice. Others, however, less credulous, assert, that *Maus Thurm* is a corruption of a word that signifies the *Tower of Tollage*; and that it was erected, that no vessel might enter the defile before they had paid the toll demanded. Bingen is a chapter of the cathedral of Mentz, from which it is distant about eighteen miles, and this chapter claims the right of tollage. From the union of the two rivers, Bingen enjoys a considerable trade in the productions of the adjacent country, chiefly timber, grain, and Rhenish wines.

From Bingen, we shall now proceed down the Rhine, with another warm admirer of that noble river, a female of whose admirable talents the public have already had such specimens, that her name alone is sufficient to excite very high expectations—We mean Mrs Radcliffe, who has published. "A Journey, made in the Summer of 1794, through Holland and the Western Frontier of Germany, with a return down the Rhine."

We have already mentioned, at Bingen, the *Maus Thurm*, or Tower of Mice. Opposite this appear the ruins of the castle of Ehren.

Ehrenfels, situate on a cliff highly elevated above the surface of the water; broken, craggy, and impending; but with vines crawling in narrow crevices, and other rocks still aspiring above it. *Ehrenfels* signifies Majestic, or Noble Rock; and *Fels*, which is the present term for rock in all the northern counties of England, as well as in Germany, is among several instances of exact similarity between the English and German language. Adjacent to the ruins of this castle is an elegant modern tower, erected by Count Ostein, in order to enjoy the enchanting view of the river. The mountain is so steep, that the only way to carry up manure is on the shoulders of the labourers; and yet its vines are esteemed among the choicest in the district of Rudesheim.

At Bingerloch, the Rhine expands into a kind of lake. Below this is one of the most dangerous parts of this river, which being at once impelled by the waters of the Nahe, compressed by the projection of its boundaries, and irritated by hidden rocks in its current, makes an abrupt descent, frequently rendered more dangerous by whirlpools, and exhibiting scenes of the true sublime, of which our Thomson had no inadequate idea.

In the passage from Bingen to Bacharach, which is about twelve miles distant, there is indeed a great variety of objects to amuse the eye: savage wildness, blended with high cultivation; extensive prospects immediately succeeded by perpendicular cliffs, that scarcely admit the day; and a multitude of castles, mouldering into ruins, on the summit of the mountains, unite to render the scene both amusing and awful.

Bacharach is a town of great antiquity; is seated in the Palatinate on the left side of the Rhine; has a considerable commerce in Rhenish wines; and is much indebted for its prosperity to the elector palatine, who has given the same privileges to the Calvinists and Lutherans as to the Roman-catholics. It is in the list of places ruined by Louis XIV. in 1689. The whole town was then so carefully and methodically plundered, that the French commander, during the last night of his stay, had nothing to sleep on but straw; and, the next day, this was employed in assisting to set fire to the town, which was soon reduced to ashes.

From Bacharach, the Rhine takes a northerly direction; and, about a mile below that town, is the borough of Kaub, a place, strong both by art and nature. Opposite this town, in the middle of the river, is the celebrated fort called the Pfalz, that is the *Palatinate*. It is not only intended to enforce the collecting of the tolls due to Kaub, but it serves occasionally as the melancholy abode of state prisoners.

Beyond Bacharach, on the same side of the river, is Oberwesel, once an imperial town, but now in the electorate of Treves. It is seated close by the river in a valley, between a high and craggy rock on the southern side, and lofty but more expanded hills on the northern. On the top of the craggy rock is the famous castle of Schonberg, which, in English, signifies *fine hill*. Oberwesel is more distinguished for its religion than any of the neighbouring cities; that is, for a superfluous number of churches and convents, steeples, bells, and altars.

Between Oberwesel and St. Goar, the Rhine is of extraordinary breadth, and the majestic mountains are covered with forests, which leave

leave space for little more than a road between their feet and the water. From some of the mountains descend rivulets, which in very wet seasons roar with angry torrents.

At Lührley, opposite Oberwesel, where the Rhine forms a kind of bay, is a rock celebrated for its echo, repeating words several times distinctly. Hence the voyager has a prospective view of the town of St. Goar, the strong fortress of Rheinfels on the rocks beyond, and of the small fortified town of Goarhausen on the opposite bank. St. Goar is in the dominions of the landgrave of Hesse Cassel. It lies at the feet of rocks on the western shore; its ramparts and fortifications spreading far along the water, and mounting in several lines among the surrounding cliffs, so as to have a striking and romantic appearance. "The Rhine, perhaps," says Mrs Radcliffe, "presents no where grander objects, either of nature or of art, than in the northern perspective from St. Goar. There, expanding with a bold sweep, the river exhibits, at one view, on its mountainous shores, six fortresses or towns, some of them placed in the most wild and tremendous situations; their ancient and gloomy structures giving ideas of the sullen tyranny of former times. The height and fantastic shape of the rocks upon which they are overhung, and the width and rapidity of the river, which unchanged by the vicissitudes of ages, and the contentions on its shores, has rolled at their feet; while generations, that made its mountains roar, have passed away into the silence of eternity—these were objects, which, combined, formed one of the sublimest scenes we had viewed."

Rheinfels is an enormous rock, impending over St. Goar, and receives its name, which signifies the Rock of the Rhine, by way of eminence, as it is the boldest and most detached of any on the river; and the stupendous and majestic fortress on its summit seems to be paramount, as it were, over all the fortresses in this part. It effectually resisted many a vigorous assault prior to the present century; but 1758, the French marquis de Castries surprised it without the loss of a man. It was restored to the landgrave in 1663; but, in 1794, it made so slight a resistance against the French, who, at the same time, became masters of St. Goar, that the governor was tried, and sentenced to death. A flying bridge maintains a communication between St. Goar and Gourhausen.

Further northward is the dismal old town of Boppard, once an imperial city, still surrounded with venerable walls, and dignified by the fine Benedictine nunnery and abbey of Marienberg, perched upon a mountain above. Boppard, like many other towns, is built on the margin of the Rhine, whence it spreads up the rocks that almost impend over the water, on which the clustered houses are scarcely distinguishable from the cliffs themselves. Here is likewise a convent of Carmelites, and another of Franciscans; and the spot is such as well suited the superstition of former times.

Half way between Boppard and Coblenz is the town of Rhens, remarkable for its vicinity to a low octagonal turret, on a small eminence, surrounded by venerable walnut-trees. This is the famous Königs Stuhl, literally *King's Seat*, where the electors used to assemble, in the fourteenth century, to choose an emperor, and deliberate on affairs of state. Nearly opposite Rhens is the small town of Oberlahnstein, which belongs to the elector of Mentz, though separated from his other dominions by those of several princes. To
such

such interfections of one territory with another the individual weakness of the German princes is partly owing; while their collected body has not only necessarily the infirmities of each of its members, but is enfeebled by the counteraction arising from an arrangement, which brings persons together to decide a question, according to a common interest, who are always likely to have an individual one of more importance to each than his share in the general concern.

The banks of the Rhine afford many instances of this disjunction of territory. The elector of Cologne has a town nearly to the southward of all the dominions of Treves. The elector palatine, whose possessions on the bank of the Rhine are intersected by those of five or six other princes, crosses the river to occupy some towns between the electorates of Mentz and Treves. The landgrave of Hesse Cassel does the same to his fortress of Rheinfels, and the elector of Mentz, in return, has a strip of land, and his chief country residence, between the dominions of two of the houses of Hesse.

Between Oberlahnstein and Niederlahnstein (that is, Upper and Lower Lahnstein) is the mouth of the Lahn, a small river, which descends from the mountains of Wetteravia on the right, and washes silver and lead-mines in its course. Near the western shore is the island of Oberworth, on which is a Benedictine convent; and beyond this are the city of Coblentz, and the opposite mountain and fortress of Ehrenbreitstein.

Not to be too minute in our descriptions of places that do not form the natural scenery of the Rhine, we shall be content to observe, with respect to Coblentz, that it presents its best front, not from the river, but as the traveller approaches from the side of Andernach. The pleasant villa of Schonbornlust, belonging to the Elector of Treves, and contiguous to the city; the majestic castle of Ehrenbreitstein, built upon a stupendous rock; the ancient palace, with its dependent hamlet, called the vale of Ehrenbreitstein, at the foot of these hills, and placed under their guardianship; the surrounding monasteries that seem to mitigate the ideas of horrid war, excited by castles and forts, by suggesting those of devout retirement; the union of the Moselle with the Rhine; the flying bridge over the latter, and the bridge of stone over the former; the distant view of lofty hills, that encircle the town in the southern direction, and, by losing themselves with the winding of the river toward the south-east, leave the imagination to follow them—all conspire to render the situation of Coblentz peculiarly picturesque.—This city was particularly celebrated as the principal asylum of the French emigrant princes and noblesse, before the commencement of the present war. It was taken by the French with many other places on the Rhine in 1794.

The vast mountain, on which stands the castle of Ehrenbreitstein, is ascended by a narrow, steep, and winding, path. The castle, which is very ancient, is not less, it is said, than 800 feet in perpendicular height from the river. It had acquired the character of impregnability from the resistance is made in the time of the Swedish wars. It has a communication with Coblentz, by subterraneous and *subaqueous* passages, cut out of the solid rock; and it is supplied with water from a well 280 feet in depth. But, with all its natural and artificial advantages, this fortress followed example of Coblentz, by an immediate surrender to the French, in October 1794.

About

About half way between Coblentz and Neuwied, on the east side of the river, is the town of Beaudorf. "This town," says Dr. Cogan, "requires some attention, on account of an iron foundery, which employs a multitude of hands; and that it is in a flourishing state is apparent from the number of neat and comfortable dwellings, placed among some that rise to respectability, and are adorned with gardens. Roman catholics, Lutherans, and Calvinists, unite harmoniously in the different occupations of the foundery, without the least quarrel concerning differences in religion. Not a single stroke of the hammer is aimed at property; nor do any of the furnaces glow for the conversion of heretics."

But a still more interesting place, about five miles further, on the same side of the Rhine, is Neuwied. It is a modern city, as its name imports, being the capital of the principality of *Wied*, and new (*Neu*) compared with every other adjacent to the Rhine. It is not surrounded by walls; which is a very unusual circumstance in a country where every place above the title of a village has its fortification. The streets are broad and straight, intersecting each other at right angles. The houses are neat, but none of them splendid, excepting the palace of the prince. The ancestors of the present prince were formerly among the richest of Germany; but a large share of property, and much political influence, have been lost in consequence of their embracing the protestant faith. Their possessions are now reduced to two boroughs, exclusive of this city, and forty or fifty villages.

It is chiefly to the sacrifice made to a good conscience, that the flourishing state of this city may be justly ascribed. Alexander, the first of the protestant line, found it necessary to improve his diminished fortunes; and he had the wisdom to connect the happiness of his people with his own pecuniary interest. He gave every encouragement in his power to every object of industry; invited foreigners to settle under his jurisdiction, by making very advantageous proposals; and, instead of suffering his mind to be embittered by the ill treatment he had experienced, he freely tolerated that religion which had persecuted him. His successors, following this excellent example, have rendered this city a flourishing colony of artists. The inhabitants amount to between six and seven thousand: it has been considerably on the increase since 1762, and now contains a number of artificers and manufacturers in almost every branch. It possesses also a printing-office, which, from the freedom granted to the press, is rising into considerable repute.

"The present prince of Neuwied," says Dr. Cogan, "in imitation of his ancestors, is the friend and father of his people. Every plan is adopted to render them industrious and happy. Not only is every species of manufacture encouraged, but every religious sect enjoys full toleration. Jews, Herhutters or Moravians, Catholics, Lutherans, and Calvinists, are permitted to worship the one Universal Father each in his own manner, and are thus habituated to consider themselves as brethren. Being children of the same parent, subjects of the same moral government, candidates alike for a future state, they are taught to reflect, that the articles in which they agree are of infinitely greater importance than those in which they differ, and that the minutiae of speculative opinions cannot annihilate the

primary duty of brotherly love. The Calvinist is the established religion; but, as we could learn, it had no other external privilege than that of tolling the bell to church; and the different sectaries, instead of being disconcerted at the sound, regulate the hours of their worship also by its summons."

"Several instances," continues Dr. Cogan, "were given us of the beneficence of this prince, and his paternal attention to the welfare of his subjects; but I shall only mention the following: As he was taking a walk with his family, he stopped at the workshop of a smith, who was standing inactive before his door. "Whence comes it," says the prince, "that I have not heard the sound of your hammer of late?"—Alas! sir, I have no iron, and a loss I sustained the last week has deprived me of the means to procure some.—"How much can you work up in a week?" "To the value of about ten crowns."—"Well!" answered the prince, "I shall inquire whether this be a fact, or whether you tell me a falsehood to excuse your indolence.—The prince, upon enquiry, was convinced of the truth of the smith's assertion, and he sent him the ten crowns the day following. The smith purchased the requisite materials: joy and gratitude gave such unusual strength to his arm, that the strokes of his hammer were heard farther than usual."

Of Andernach, further down on the opposite shore, with its prodigious floats of timber, and the remainder of the Rhine to Bonn, we have already given Dr. Cogan's description.

From Neuwied to Bonn the Rhine keeps a north-westerly course. Bonn is principally distinguished as the favourite residence of the Elector of Cologne, and by a celebrated university. It contains about 12,000 inhabitants. The gardens of the electoral palace are magnificent, and are open to the public.

After leaving Bonn, the shores have little that is interesting, unless in the retrospect of the Seven Mountains, with rich woodlands undulating at their feet; and when these, at length, disappear, the Rhine loses, for the rest of its course, the wild and sublime character which distinguished it between Bingen and Bonn. The rich plain which it waters between the latter place and Cologne is studded at every gentle ascent that bounds it with abbies and convents, most of them appropriated to the maintenance of noble chapters. Besides these, the Rhine passes no less than twenty villages in its course from Bonn to Cologne, a distance, by water, of about five-and-twenty miles.

Cologne, one of the most ancient and formerly one of the most commercial cities in Europe, appears, when viewed from the river, with more of ancient majesty than from any other point. Its quays, extending far a long the bank; its lofty ramparts shaded with old chestnuts, and crowned by many massy towers, black with age; the old gateways opening to the Rhine; and the crowd of steeples, overtopping all, give it a venerable and picturesque character. For a description of this city we refer to Dr. Cogan's work, and particularly to his twenty-seventh and twenty-ninth letters, in the first of which he proves, from the character of the inhabitants of Cologne, that religious pomp and splendour have no beneficial influence upon morals, and that ecclesiastical government is of all others the most pernicious; in the last he minutely investigates the causes of the decay of this once-flourishing city.

Three miles below Cologne, on the opposite bank, is Mulheim, a small town in the palatinate, where the few protestants of Cologne have a church, as they are not allowed to have one in the city.

The banks of the Rhine are now less enlivened by villages than in the districts from Mentz to Cologne. Corn-lands, with a slight intermixture of wood, border the river hence to Dusseldorf; and the stream, which is now wider and less rapid, flows, with an even force, through long reaches, scarcely distinguished from each other by any variety of country, or intervention of towns.

Dusseldorf, the principal town of the duchy of Berg, is subject to the elector palatine. It is seated on the Rhine and on the small river Dussel, from which last it modestly takes its name, which signifies the Village on the Dussel. From a village, it is become a lively populous city; contains eighteen thousand inhabitants, including the garrison; and is celebrated for its gallery of paintings, one of the largest and best selected collections in Europe. These pictures having been removed, with those of Manheim, to Munich in Bavaria, fortunately escaped falling into the hands of the French, on the surrender of this place.

From Dusseldorf, the Rhine proceeds by the island and town of Kayserwerth; Duisburg, seated also on the Roer, and in the vicinity of forests still celebrated for herds of wild horses; Rheinberg; Wesel, a town, with a citadel which is a state prison belonging to the King of Prussia; Burick, Xunten, Rees; and Emmerick, a considerable town in the duchy of Cleves, 8 miles east of the capital of that name.

Below Emmerick, the majestic Rhine first enters the rich Batavian meads, but merely to encounter misfortune and disgrace. We first meet with the Betuwe, (the ancient Batavia,) an oblong island, formed by the division of the Rhine into two streams. That which bends to the west takes the name of the Wahl; and, passing by Nimeguen, joins the Maese near Bommel, and at Worcum loses its usurped distinction in the name of this last river. The Maese, below Worcum, expands into a great lake, called the Bies Bosch, on the west side of which is the island and city of Dort. It then divides into four principal branches, forming the island of Ysselmonde, Voorn, and Overflackee. The most northern branch is called the Merwe, and, passing by Rotterdam and Schiedam, is joined by the branch from the south side of Ysselmonde, and enters the German Ocean below the Briel. The other two branches make their exit at Helvoetsluys and the island of Goree. The other stream, which, below Emmerick, had branched off to the right, retains its ancient name for a few miles, when another stream branches off to the north, takes the name of Yssel, and passing by Doesburg, Zutphen, Deventer, and the Hattum, enters the Zuider Sea below Compen. The old river is still recognized after this separation, and the town of Rhenen takes its name from it; but, at Wyck-by-Duerstede, it again divides into two streams; that to the left takes the name of the Leek, and, passing by Vianen and Culemburg, enters the Merwe above Rotterdam. With respect to the branch to the right, which still retains its ancient name, we shall give its fate, and the conclusion of our history of this celebrated river, in the words of Dr. Cogan;

"There is scarcely an instance in all geography, in which a river of such respectability has been so unfortunate, or so ill-treated, as the Rhine." Then, describing the different branches already mentioned, he proceeds to give the causes of the present degraded state of the stream, which, proceeding to the right of Wyck-by-Duerstede, still retains its ancient appellation. Its disgrace began at Wyck-by-Duerstede. An unfortunate accident was the original cause of it. The Rhine, in the days of its superabundance, threw off a branch called the Leck, near to the above-mentioned city; and, without the most distant suspicion of future rivalry, directed its course towards Utrecht, gave the name of *Ultra-trajectum* to that municipal town, passed through and dignified Woerden, Leyden, and several large and populous villages, and finally emptied its accumulated mals of water into the German ocean at Catwyk. Now it unfortunately happened, in one of those inundations to which the Low Countries are so much exposed, and which frequently threaten their total ruin, that the deluge enlarged and deepened the channel of the Leck in such a manner, that, when the waters subsided, the large stream of the Rhine was directed into this other channel, and scarcely any thing remained of the old bed, but a miserable brook, and the venerable name! What renders its state still more humiliating is, this remaining stream, deprived of its original force to bear down obstructions, and to make its way into the sea, is absolutely and literally choked up by mountains of sand, which the tides have brought with them, and the winds accumulated; is stopped in its course near the village of Catwyk; and, being thus obliged to regurgitate, is dissipated and lost amid the stagnated canals of Holland! What a melancholy end for one of the noblest rivers in Europe, the theme of poets, and frequent barrier to the rage of warriors!

THE INSTRUCTIVE NATURALIST, No. VII.

OF GENERATION.

MANY of the causes which contribute to the formation of a living body have hitherto eluded human research; may in all probability never be discovered; and perhaps are beyond human comprehension. Some philosophers, considering the extreme divisibility of matter, and learning from the microscope that transformation is but the development of certain parts that previously existed, have thence imagined that generation is somewhat analogous; that all regularly organised bodies received their form at the beginning; that the first of every genus and species contained by involution the numerous millions of succeeding generations; and that the union of the two sexes gives only a stimulus, and brings into view forms that had existed since the world began.

This hypothesis has attempted to explain a thing that is unknown by what must for ever remain incomprehensible to the human mind in its present state. It appeals absurdly from observation to conjecture; and supposes that bodies which are originally brought into view, which are daily augmented, frequently repaired, and sometimes renewed, by organic action, do nevertheless in their first formation require an effort superior to what omnipotent power is able to perform by secondary agents.

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Had the supporters of this hypothesis considered that many herbaceous plants produce new flowers when the first set are untimely cut off, that lobsters and many a species of insect renew their limbs, and that certain polypes can raise so perfect vegetable forms as to puzzle the naturalist whether or not he should class them under plants; they would not surely have prescribed such bounds to omniscient wisdom and almighty power, or declared with such confidence what the Author of Nature, to speak with the vulgar, must necessarily perform by his own hands, or what he may intrust to secondary causes regulated by his laws.

These philosophers will find it difficult to account in a very satisfactory manner for monstrous productions, and for those changes of structure and of form which for a while continue hereditary from the influence of habit. They object to others, that all the parts of a living body are mutually dependent on one another, and that they must necessarily have been coeval or existed at once. But, though every attempt that has yet been made to ascertain which of the vital organs are prior and which posterior in a living body has proved unsuccessful, it has not been demonstrated that either themselves or their functions are coeval. It may, on the contrary, be plainly demonstrated from observation, that the lungs and the stomach do not begin to perform their functions so early as the heart and the vascular system; that the heart and its system perform their functions, even with some considerable changes, immediately after birth; that the vegetable tribes are without nerves; and that brain and nerves in the animal kingdom perform more and more of their functions as the system approaches towards maturity. It has even been shewn that bones will unite, and the limbs of an animal continue to be nourished, without nerves; that there is a principle of life in the blood; that the heart will act under other stimuli besides that of nerves; and that sound logic does by no means require us to suppose that the first actions of the foetal heart, or the *punctum saliens*, are owing to the influence of stimuli from the brain, or that the brain must have existed when the heart first moved.

Although the minuteness and transparency of the parts may prevent us from seeing the first gradual formation of the embryo, yet every observation corroborates the opinion that it is formed by secondary causes, and through the medium of organic powers.

It has been asked, whether or not is the embryo formed by the joint operation of the two sexes? or is it formed entirely by the one, and brought into action by a stimulus from the other? The former of these questions supposes that each of the sexes has a feminal fluid; that some mixture takes place in the uterus, and produces an embryo, in the same manner that a neutral salt assumes a certain and determinate form. The notion implies some general and confused idea of chemical combination; but does not bespeak a very clear head, profound reflection, or much acquaintance with the nature and properties of living bodies.

For a long time past the most rational physiologists have generally agreed that the embryo is formed gradually and slowly in one or other of the two sexes, not by chemical combination and mixture, but a system of organs, directed by laws and prompted by stimuli, with many of which we are yet unacquainted. From the great Hippocrates downwards to Aquapendens and Harvey, the credit of furnishing

furnishing the foetal embryo was almost universally given to the females of those animals which are named oviparous. Among the viviparous, appearances were such, that the female was left to contest it with the male. At last the eclat of Leeuwenhoek's discoveries seemed to put an end to all doubts entertained upon the subject. He very plainly saw through his microscope that very great profusion of particles that move to and fro with amazing rapidity in the male semen. Upon this he embraced the doctrine of Hamme, who had seen them before, and supposed from their motions that these particles were not only animalcules, but the principles or rudiments of that animal in whom they were formed, and that they were deposited in the uterus of the female only to be nourished and augmented in size.

What raised suspicions against this theory were the numerous animalcules discoverable by the microscope in other fluids, and that vast profusion of young embryos in those cases where never more than one or two arrive at maturity. It was an objection to it, that some females had been impregnated where the hymen remained unbroken, and where the vulva had been shut so closely as to leave only a passage for the urine. The male semen in these instances could have reached only the mouth of the uterus. It was another, that in all birds which have no intrant penis the male semen is never sent farther than the mouth of the vulva, and that a single act of the male impregnates the whole eggs of the ovarium. A third objection is the pollen of flowers, which is not applied immediately to the seed, but often to a distant part of the vessel in which it is contained. A fourth may be taken from frogs and fishes, and all those animals whose eggs are impregnated after emission. And, lastly, Haller had observed the pullet completely formed in those eggs that were not fecundated.

Supposing animalcules in every kind of prolific semen, yet it frequently happens that this semen undergoes a change before it can be applied to the embryo. The semen of the frog is dissolved in water; and that which is injected disappearing suddenly after coition, would seem to intimate, that in those animals which have been examined it had met with a solvent somewhere in the uterus, and produced its effect after the change. It is now, we believe, pretty generally known, that the embryo does not commence its existence in the cavity of the uterus. De Graaf observed it on its passage down the Fallopian tube; he saw the place where it first began in the testicle of the female; and cases have occurred where it has missed the Fallopian tube, where it has fallen into the abdomen, where the placenta has been formed, and the foetus has grown among the viscera of the lower belly.

From these facts it has been concluded, notwithstanding some feeble objections, that the female testicles are real ovaries containing eggs; that these eggs are brought into action by the stimulating power of the male semen, which is sometimes thrown into the cavity of the uterus, sometimes applied only to its mouth, and sometimes sprinkled over the egg after emission. The principal difference, therefore, that occurs between oviparous and viviparous animals, considered as such, appears to be this: the former are accustomed to eject their embryo before it escapes from the membranes of the egg; the latter retain it long in the uterus, until it acquires a considerable

siderable size, until the membranes can hold it no longer, and then eject it when the membranes are burst. A plant is oviparous when it yields seed; viviparous when it produces a gem, a bud, a bulb, or an eyed root. The membranes of the seed being removed, an incipient embryo is seen through the microscope.

Some animals, according to the season, eject the embryo inclosed in its membranes, or retain it in the uterus till the membranes are broken. These are the animals which are said to be oviparous at one period and viviparous at another. The spider-flies retain their young till they be as large as the natural size of their own bodies, and have undergone all their transformations within the expansile membranes of the egg, and an uterus as expansile as the stomach of a serpent.

In most cases generation requires a temporary union of two sexes: but it has been said, that in Senegal there is a species of shell-fish among whom this operation is the joint work of three individuals. In our own country, too, three frogs are frequently observed adhering together, though the labours of the third have generally been thought more officious than necessary. In some animals the sexual union is almost instantaneous. It constitutes nearly the business of life in the last stage of the ephemeron; and the male both of the frog and toad often continues on the back of the female not for hours and for days only, but for some weeks. Upon examination it has been found, that with his fore-feet he assists the female to protrude her eggs through the windings of the oviduct; and, when they at last arrive at the anus, a species of the toad has been observed to draw them out with his hind legs. These animals were probably the first of the masculine gender who practised this art. But due honour has not been ascribed to the discoverers. In former days, the generous and grateful spirit of the ancients made them ready to acknowledge their obligations to different animals for the arts of bleeding, clystering, and purging; but such is the degeneracy of modern times, that many write only to claim the discoveries of others. On this account we ought not to wonder that many accoucheurs, in publishing encomiums on their own merit, have invidiously concealed the superior pretensions of the obstetrical toad.

Among all living bodies the two sexes are generally similar; and the male sex generally distinguished by superior strength, beauty, and courage. The law, however, does not hold universally. The females of some carnivorous animals, who are left by the male to provide for their offspring, are larger, stronger, and more ferocious, than he. Among some insects the male and female have no similarity even in form. The male of the glow-worm is a beetle, which flies in the dark, and is attracted not by the form, but the brilliancy, of his mistress. The female gall-insect is a large mass like a vegetable excrescence, without locomotion; the male a small fly full of activity. The one is as unlike to the other as a Harpy to a Venus, and as disproportioned in point of bulk as a horse to an elephant.

In many animals the distinctions of sex are concealed in the body. When any of their parts are placed externally, or protruded occasionally, the male parts are usually prominent, and the female hollow, in order to receive them. In the acari, however, in many flies,

flies, and a few hornets, the case is reversed; the female parts suffer erection, and the male parts are open and hollow for their reception.

The external situation of these parts is very much varied in different animals. In many worms it is near to the head. It is often upon the side of the snail; near to the breast in the female of the dragon-fly. It is at the extremity of the antennæ in the male spider. The vulva enters from the rectum in birds. Its common situation in most animals is well-known.—The male penis, where there is one, is sometimes found to enter the vulva, and sometimes not: it is sometimes imperforated, sometimes forked, sometimes double, sometimes fleshy, sometimes bony, sometimes straight, sometimes winding spirally like a screw, sometimes with a knob and sometimes with a point at its extremity, according to the kinds and varieties of animals.

Few individuals have more than one sex. Many snails, however, are androgynous, and have two. In copulation they perform the office of two sexes, and are mutually impregnated. This circumstance has often led the sensualist to wish that he were a snail. With equal reason the Epicure might wish to be one of those worms that imbibe by absorbents, and suck in nourishment by a thousand mouths. The organs employed may be more in number, the continuance of their function may be much longer, and yet the gratification may be less. The discreet beauty can afford a million of pleasures to her lover which no snail or sensualist enjoys, and which prostitution can never yield.

The male and female parts of the vegetable are sometimes both on the same flower, sometimes on separate flowers, and sometimes even on different plants of the same species. Besides the flower, another organ of generation is found in vegetables. This is the corona, from which the buds and branches proceed. It is a substance between the pith and the ligneous circles, and from which the diametral insertments diverge.

The corona is most conspicuous at the time when it sends forth shoots. The flower comes forth only at the time when the seed is to be formed; and the testicles and ovaries of those animals which procreate only at stated periods are diminished in size, and sometimes disappear, till the genial season. Even some females, when they cease to be prolific, as the pheasant, for instance, assume many marks of the other sex, as if their former sex had been assumed only for a while, and to answer some temporary purpose.

In all animals the incipient embryos are perhaps neuters, and the sex determined according to the predominancy of the male or female stimulus on the parts. It would not a little confirm this opinion, were the observation to be well-founded, that certain bulls are very apt to beget males and others females, and that certain cows which have females always when they are young bring forth males when they grow old. The different proportions of males and females in different climates might also serve to illustrate this doctrine. It is no objection to it that the order of male and female births in the same family is often irregular. The proportional force of the two stimuli will naturally be different at different times. It may depend on the quantity or quality of the fluid secreted, upon the difference of ardour in the parties, on the fancy, the passions, the particular state of
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the system at the time, and a thousand circumstances, besides the age, and the usual or general habit of the body. We mean only to infer at present, that, wherever a male or female is produced, the stimulus of that particular sex, whatever was the cause, had during the time of coition and conception acquired the ascendancy over the parts that were to become sexual in the embryo. We cannot so readily answer the question, Why the offspring should possess the form and dispositions of one parent, and the sex of the other? In this case the different stimuli may have acted differently on different parts; in the case of hermaphrodites, which are very common in the horse, the ass, the cow, and the sheep, the two parents seem to divide the form, the sex, and the dispositions, equally between them.

The particular cause which excites the orgasmus in the female organs is not ascertained. That viscous fluid, which young lascivious females eject when fond of the male, is chiefly a secretion from the glands of the vagina, the mouth of the uterus, and the neighbouring parts. In some respects it appears to be similar to those periodical discharges of females which frequently assume the erect posture; and, these discharges being usually discontinued during the times of pregnancy and suckling, we must suppose that it is a portion of that fluid which nature has prepared for the use of the fœtus. These discharges are always a proof that the female has arrived at the age of puberty; that her ovary is now performing its office; and that she is disposed to propagate her kind. Whatever be the cause of the female orgasmus, it is often so strong as to counteract the natural effects of the seminal fluid, and prevent impregnation. For this reason, few young and lascivious females conceive immediately after their marriage; and after coition, therefore, in cattle, it is sometimes a practice to beat the female, to plunge her in water, to weary her with running, and to use other means to prevent the return of the sexual desire.

In man, and some of the nobler animals, the influence of fancy over the organs of generation is unquestionably great; but the extent and mode of its agency is not defined. Those who allow it so much power in impressing marks, and altering the form and colour of the fœtus, support their opinion rather by the number than the strength of their arguments. Many of the stories which they adduce as a sort of proofs are evidently fabulous, and have brought the truth of the whole into question. The reports, however, of the French commissioners who were appointed to examine the nature of animal magnetism, ought to deter the candid inquirer from drawing very hasty conclusions.—The queries of Fienus concerning the powers of this mental faculty are important and curious, and might be of use in directing our researches; but they ought to be answered by accurate experiments, and not by acute metaphysical reasoning and historical anecdotes that are ill authenticated.

To prevent a confusion of genera and species, animals are generally restricted by propensity to their own kind; and the seminal fluids, besides, being various in various animals, they cannot indiscriminately act as a stimulus on all female organs of generation. The changes of form induced by habit, which is owing itself to the influence of stimuli, will partly explain the manner in which the progeny is made to resemble the male. As the irritability of

different parts is of different kinds, the stimulus will have a different effect on different organs; and in these cases, where either genera or species are mixed, the parts which are most and least affected by the stimulus of the male will be obvious in the shape and form of the offspring.

We have hitherto spoken of generation as being performed by the temporary intercourse of two sexes; but the puceron is an instance where sexual distinctions are not always necessary. Even where they exist, they are daily dispensed with in the vegetable kingdom. Plants grow from the gem, the bulb, the leaf, or the root.—They propagate by slips, by suckers, and by layers, and some of them multiply by spontaneous separation. In many animals the distinctions of sex are totally unknown. It has been observed, that infusory animalcules multiply their species by continual divisions and subdivisions of their own body; that some polypes, by spontaneous separation, split transversely, some longitudinally, and that some send off shoots. When experiments have been made upon these animals, it has been discovered that the numerous and artificial divisions of their body or their head produce entire animals. Trembley learned that they might be engrafted upon one another, and produce monsters as wild and extravagant as poet or fabulist has ever dreamed of.

It was noticed before, that the alimentary canal of some animals distributed nourishment through the whole body without the intervention of circulating vessels, and that the vital organs of vegetables were generally diffused through the whole system. The case is the same in polypes as in plants. Every part is a miniature of the whole. It is found to have similar organs of digestion, of respiration, of circulation, and of generation. In perfect animals all the parts are more dependent on one another; the vital organs have distinct situations, and their powers are concentrated in distinct places. The arm of a man has no heart; it has no lungs; it has no stomach, and no organs of generation; but the branch of a tree has as complete a system of organs as the trunk itself, and is as independent of that body from which it grew as the graft is independent of the stock.

The several parts of perfect animals all contribute to make one whole; the several parts of a plant or polype, when united together, form only a congeries of living bodies. These facts contribute to explain the principal phenomena in this mode of propagation.

OF NATURAL AND ARTIFICIAL MARBLE.

MARBLE is a genus of fossils; composed of small separate concretions, moderately hard, not giving fire with steel, fermenting with and soluble in acid menstrua, and calcining in a slight fire.—The word comes from the French *marbre*, and that from the Latin *marmor*, of the Greek *μαρμαρειν*, to “shine or glitter.”

The colours by which marbles are distinguished are almost innumerable; but the most remarkable are, 1. The black marble of Flanders. 2. Plain yellow. 3. Yellow with some white veins. 4. Yellow with black dendrites. 5. Yellow with brown figures resembling ruins. 6. Black and yellow. 7. Black and white. 8. Pale yellow, with spots of a blackish-grey colour. 9. Yellow, white,

white, and red. 10. Pale yellow. 11. Olive coloured, with deeper coloured cross lines, and dendrites. 12. Brownish red. 13. Flesh coloured and yellow. 14. Common red marble. 15. Crimson, white, and grey. 16. Reddish-brown lumps, on a whitish ground. 17. Bluish grey. 18. Snowy-white.

The varieties of marble, numerous as they are, have been improperly augmented by virtuofos, and some people who collect specimens for the sake of gain. The Italians are particularly curious in this way; and most of the names imposed upon marbles are given by them. Every marble brought from an unknown place is called by them *antico*; when distinguished by a number of bright colours, it is called *brocatella*, or *brocatellato*. When they want some of the originals to complete a whole set of marbles, they either substitute others which have the nearest resemblance to them; or, lastly, they stain white marbles according to their own fancy, and impose them on the world as natural. The finest solid modern marbles are those of Italy, Blankenburg, France, and Flanders. It has also been lately discovered, that very fine marble is contained in some of the western Islands of Scotland. Those of Germany, Norway, and Sweden, are of an inferior kind, being mixed with a kind of scaly limestone; and even several of those above mentioned are partly mixed with this substance, though in an inferior degree. Cronstedt however mentions a new quarry of white marble in Sweden, which, from the specimens he had seen, promised to be excellent.

The specific gravity of marble is from 2700 to 2800; that of Carrara, a very fine Italian marble, is 2717.—Black marble owes its colour to a slight mixture of iron. Mr. Bayen found some which contained 5 per cent. of the metal; notwithstanding which the lime prepared from it was white, but in time it acquired an ochry or reddish-yellow colour.

Marble, when chemically examined, appears to consist of calcareous earth united with much fixed air; and is, like limestone or chalk, capable of being converted into a strong quicklime.—Dr. Black derives the origin of marble, as well as limestone and marble, from the same source, viz. from the calcareous matter of shells and lithophyta. In one kind of limestone known by the name of *Portland-stone*, and consisting of round grains united together, it was supposed to be composed of the spawn of fish; but comparisons of other phenomena have explained it. It is plain that it hath been produced from a calcareous sand, which is found on the shore of some of the islands in the southern climates. By the constant agitation the softer parts are worn off, and the harder parts remain in the form of particles that are highly polished, and which are afterwards gradually made to concrete together by causes of which we have yet no knowledge.—There are indeed some few of the limestones and marbles in which we cannot discover any of the relics of the shells; but there are many signs of their having been in a dissolved or lignified state; so we cannot expect to see the remains of the form of the shells: but even in many of the marbles that have the greatest appearance of a complete mixture, we still find often the confused remains of the shells of which they have been originally composed. We should still find it difficult to conceive how such masses should have derived their origin from shells; but, considering the many collections that we have an opportunity of seeing in their steps towards

this process, and a little concreted together, so that by their going a step farther they might form limestone and marbles, we shall soon see the possibility of their being all produced in the same manner. Thus vast quantities of shells have been found in the province of Turin in France: and indeed there is no place where they have not been found. The lithophyta likewise seem to be a very fruitful source of this kind of earth. In the cold climates, where the moderate degree of heat is not so productive of animal-life, we have not such an opportunity of observing this: but in the hot climates, the sea, as well as the land, swarms with innumerable animals; and, at the bottom, with those that produce the corals and madripores. We learn from the history of a ship that was sunk in a storm in the Gulf of Mexico, the vast growth there is of these bodies. About 30 years after, they attempted to dive into it to get out a quantity of silver; but they found great difficulty in getting it, from the ship being overgrown with coral. Sir Hans Sloane, in the Philosophical Transactions, and in his History of Jamaica, observes, that the ship's timber, the iron, and money, were all concreted by the growth of the calcareous matter. So in a tract of many thousands of years the quantity of it should be very great; and, as this is going on through a very great extent of the bottom of the sea, it will produce very extensive as well as massy collections of calcareous matter.

According to Sir William Hamilton, many variegated marbles and precious stones are the produce of volcanoes.

The stucco, or artificial marble, whereof they make statues, busts, basso-relievos, and other ornaments of architecture, ought to be marble pulverized, mixed in a certain proportion with plaster; the whole well sifted, worked up with water, and used like common plaster.

There is also a kind of artificial marble made of the flaky selenites, or a transparent stone resembling plaster; which becomes very hard, receives a tolerable polish, and may deceive a good eye. This kind of selenites resembles Muscovy talc. There is another sort of artificial marble formed by corrosive tinctures, which, penetrating into white marble to the depth of a line or more, imitate the various colours of other dearer marbles.

There is also a preparation of brimstone in imitation of marble. To do this, you may provide yourself with a flat and smooth piece of marble; on this make a border or wall, to encompass either a square or oval table, which may be done either with wax or clay. Then having several sorts of colours, as white lead, vermilion, lake, orpiment, masticot, smalt, Prussian blue, &c. melt on a slow fire some brimstone in several glazed pipkins; put one particular sort of colour into each, and stir it well together; then, having before oiled the marble all over within the wall, with one colour quickly drop spots upon it of larger and less size; after this, take another colour and do as before, and so on till the stone is covered with spots of all the colours you design to use. When this is done, you are next to consider what colour the mass or ground of your table is to be; if of a grey colour, then take fine sifted ashes, and mix it up with melted brimstone; or, if red, with English red ochre; if white, with white-lead; if black, with lamp or ivory black. Your brimstone for the ground must be pretty hot, that the coloured drops on the stone may unite and incorporate with it. When the ground is poured even all over,

over, you are next, if judged necessary, to put a thin wainscot board upon it: this must be done whilst the brimstone is hot, making also the board hot, which ought to be thoroughly dry, in order to cause the brimstone to stick the better to it. When the whole is cold take it up, and polish it with a cloth and oil, and it will look very beautiful.

ELASTIC MARBLE is an extraordinary species of fossil which has surprised all the naturalists who have seen it. There are several tables of it preserved in the house of Prince Borghese at Rome, and shewn to the curious. F. Jacquer, a celebrated mathematician, has given a description in the Literary Gazette of Paris, but the naturalists cannot be contented with it. If permission was given to make the requisite experiments, this curious phenomenon might be better illustrated. There are five or six tables of that marble; their length is about two feet and a half, the breadth about ten inches, and the thickness a little less than three. They were dug up, as the Abbé Fortis was told, in the feod of Mondragone; the grain is of Carrarese marble, or perhaps of the finest Greek. They seem to have suffered some attack of fire: though the first degree of pulverization observable in the angles, can, perhaps, scarcely be called that of imperfect calcination. They are very dry, do not yield to external impression, resound to the hammer, like other congenerous marble, and are perhaps susceptible of a polish. Being set on end, they bend, oscillating backward and forward; when laid horizontally, and raised at one end, they form a curve, beginning towards the middle; if placed on a table, and a piece of wood or any thing else is laid under them, they make a salient curve, and touch the table with both ends. Notwithstanding this flexibility, they are liable to be broken if indiscreetly handled; and therefore one table only, and that not the best, is shewn to the curious. Formerly they were all together in the prince's apartment on the ground-floor.

COLOURING OF MARBLE.

This is a nice art; and, in order to succeed in it, the pieces of marble on which the experiments are tried, must be well polished, and free from the least spot or vein. The harder the marble is, the better will it bear the heat necessary in the operation; therefore alabaster and the common soft white marble are very improper for performing these operations upon.

Heat is always necessary for opening the pores of marble, so as to render it fit to receive the colours: but the marble must never be made red-hot; for then the texture of it is injured, and the colours are burnt, and lose their beauty. Too small a degree of heat is as bad as one too great; for, in this case, though the marble receives the colour, it will not be fixed in it, nor strike deep enough. Some colours will strike even cold; but they are never so well sunk in as when a just degree of heat is used. The proper degree is that which, without making the marble red, will make the liquor boil upon its surface. The menstruums used to strike in the colours must be varied according to the nature of the colour to be used. A lixivium made with horse's or dog's urine, with four parts of quicklime and one of pot-ashes, is excellent for some colours; common ley of wood-ashes is very good for others; for some, spirit of wine is best; and lastly, for others, oily liquors, or common white-wine.

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The colours which have been found to succeed best with the peculiar menstruums, are these. Stone-blue dissolved in six times the quantity of spirit of wine, or of the urinous lixivium, and that colour which the painters call litmus, dissolved in common ley of wood-ashes. An extract of saffron, and that colour made of buckthorn berries, and called by painters sap-green, both succeed well when dissolved in spirit of wine. Vermilion, and a very fine powder of cochineal, also succeed very well in the fameliquors. Dragoon's-blood succeeds in spirit of wine, as does also a tincture of logwood in the same spirit. Alkanet-root gives a fine colour: but the only menstruum to be used for it is oil of turpentine; for neither spirit of wine, nor any lixivium, will do with it. There is another kind of sanguis draconis, commonly called dragon's-blood in tears, which, mixed with urine, gives a very elegant colour.

Beside these mixtures of colours and menstruums, there are other colours which must be laid on dry and unmixed. These are, dragon's-blood of the purest kind, for a red; gamboge, for a yellow; green wax, for a green; common brimstone, pitch, and turpentine, for a brown colour. The marble for these experiments must be made considerably hot, and then the colours are to be rubbed on dry in the lump. Some of these colours, when once given, remain immutable, others are easily changed or destroyed. Thus, the red colour given by dragon's-blood, or by a decoction of logwood, will be wholly taken away by oil of tartar, and the polish of the marble not hurt by it.

A fine gold colour is given in the following manner:—Take crude sal ammoniac, vitriol, and verdigrise, of each equal quantities. White vitriol succeeds best; and all must be thoroughly mixed in fine powder.

The staining of marble to all the degrees of red or yellow, by solutions of dragon's-blood or gamboge, may be done by reducing these gums to powder, and grinding them with the spirit of wine in a glass mortar. But, for smaller attempts, no method is so good as the mixing a little of either of those powders with spirit of wine in a silver spoon, and holding it over burning charcoal. By this means a fine tincture will be extracted: and, with a pencil dipt in this, the finest traces may be made on the marble while cold; which, on the heating of it afterwards, either on sand, or in a baker's oven, will all sink very deep, and remain perfectly distinct on the stone. It is very easy to make the ground-colour of the marble red or yellow by this means, and leave white veins in it. This is to be done by covering the places where the whiteness is to remain with some white paint, or even with two or three doubles only of paper; either of which will prevent the colour from penetrating. All the degrees of red are to be given to marble by this gum alone; a slight tincture of it, without the assistance of heat to the marble, gives only a pale flesh colour: but the stronger tinctures gives it yet deeper; to this the assistance of heat adds greatly; and finally, the addition of a little pitch to the tincture, gives it a tendency to blackness, or any degree of deep red that may be desired.

A blue colour may be given also to marble by dissolving turnsol in lixivium, in lime and urine, or in the volatile spirit of urine; but this has always a tendency to purple, whether made by the one or the other of these ways. A better blue, and used in an easier manner,

ner, is furnished by the Canary turnsol, a substance well known among the dyers. This needs only to be dissolved in water, and drawn on the place with a pencil: it penetrates very deeply into the marble; and the colour may be increased, by drawing the pencil wetted afresh several times over the same lines. This colour is subject to spread and diffuse itself irregularly: but it may be kept in regular bounds, by circumscribing its lines with beds of wax, or any such substance. It is also to be observed, that this colour should always be laid on cold, and no heat given even afterwards to the marble: and one great advantage of this colour is, that it is therefore easily added to marbles already stained with other colours, is a very beautiful tinge, and lasts a long time.

NATURAL HISTORY OF THE MERMAID.

HOWEVER naturalists may doubt of the reality of mermaids or mermen, we have testimony enough to establish it; though, how far these testimonies may be authentic, we cannot take upon us to say. In the year 1187, as Laray informs us, such a monster was fished up in the county of Suffolk, and kept by the governor for six months. It bore so near a conformity with man, that nothing seemed wanting to it but speech. One day it took the opportunity of making its escape; and plunged into the sea, was never more heard of. *Histoire d'Angleterre*, P. I. p. 403.

In the year 1430, after a most violent tempest, which broke down the dikes in Holland, and made way for the sea into the meadows, &c. some girls of the town of Edam in West-Friesland, going in a boat to milk their cows, perceived a mermaid embarrassed in the mud with a very little water. They took it into their boat, and brought it with them to Edam, dressed it in women's apparel, and taught it to spin. It fed like one of them, but could never be brought to offer at speech. Some time afterwards it was brought to Haerlem, where it lived for some years, though still shewing an inclination to the water. Parival relates, that they had given it some notion of a Deity, and that it made its reverences very devoutly whenever it passed by a crucifix. *Délices de Hollande*.

In the year 1560, near the island of Manar, on the western coast of the island of Ceylon, some fishermen brought up, at one draught of a net, seven mermen and mermaids; of which several Jesuits, and among the rest F. Hen. Henriques and Dimas Bosquez, physicians to the viceroy of Goa, were witnesses. The physicians, who examined them with a great deal of care, and made dissection thereof, asserts, that all the parts both internal and external were found perfectly conformable to those of men. See the *Hist. de la Compagnie de Jésus*, P. ii. T. iv. No. 276. where the relation is given at length.

We have another account of a merman, seen near the great rock called Diamond, on the coast of Martinico. The persons who saw it, gave in a precise description of it before a notary. They affirmed that they saw it wipe its hand over its face, and even heard it blow its nose.

Another creature of the same species was caught in the Baltic in the year 1531, and sent as a present to Sigismund king of Poland, with whom it lived three days, and was seen by all the court. Another

ther very young one was taken near Rocca de Sintra, as related by Damian Goes. The king of Portugal and the grand master of the order of St. James are said to have had a suit at law to determine which party these monsters belong to.

In Pontopidan's Natural History of Norway, also, we have accounts of mermaids; but not more remarkable or any way better attested than the above.

In the year 1794, a mermaid was shewn at Mr. Elliott's, No. 7, New Broad Court, Bow-street, Covent Garden, said to have been taken in the north seas by Captain Fortier. This wonderful Nymph of the Sea, half a woman from the head down to the lower part of the waist, and half a fish from thence downwards, was three feet long having ears, gills, breasts, fins, shoulders, arms, hands, fingers, and a contiguous scale covering the fish part.

In May, 1775, a mermaid was exhibited in London, said to have been taken in the Gulph of Stanchio, in the Archipelago, or Egean Sea, by a merchantman trading to Natolia, in August, 1774.—The most striking difference between this (of which an engraving is given in the Gentleman's Magazine, vol. xlv.) and the one described above, as exhibited in 1794, and from which our drawing was taken, is in the formation of the arms, which in the former are the full length of those of an ordinary woman, whereas those of the latter, as is evident from our engraving, are closely joined to the body, and indeed are only fins formed like hands.—The description which accompanies the plate of that shewn in 1775 is as follows: Its face is like that of a young female; its eyes a fine light blue; its nose small and handsome; its mouth small; its lips thin, and the edges of them round like that of the codfish; its teeth are small, regular, and white; its chin well shaped, and its neck full. Its ears are like those of the eel, but placed like those of the human species, and behind them are the gills for respiration which appear like curls. Some are said to have hair upon their head; but this has only rolls instead of hair, which at a distance might be taken for short curls. But its chief ornament is a beautiful membrane or fin rising from the temples, and gradually diminishing till it ends pyramidically, forming a foretop like a lady's head-dress. It has no fin on the back, but a bone like that of the human species. Its breasts are fair and full; the arms and hands are well proportioned, but without nails on the fingers; the belly is round and swelling, but there is no navel. From the waist downwards the body is in all respects like the codfish; it has three sets of fins, one above another, below the waist, which enable it to swim erect on the sea.

OF ANDROGYNES, OR HERMAPHRODITES.

ANDROGYNE is a name given to those living creatures which, by a monstrous formation of their generative parts, seem to unite in themselves the two sexes, that of the male and of the female. This *lusus nature*, this defect, or perhaps redundancy, in the animal structure, is described by medical authors in the following manner. "There is a depravation in the structure of the parts intended by nature for propagation, when, besides those concealed parts that are found necessary for the discharge of prolific functions, the pudenda

of the other sex likewise appear. This monstrous production of nature is diversified in four different ways; of which three appear in males and one in females. In men, the female pudendum, clothed with hair, sometimes appears contiguous to the perinæum; at other times, in the middle of the scrotum; at other times, which constitutes the third diversity, through that part itself which in the midst of the scrotum exhibits the form of a pupendum, urine is emitted. Near that part which is the test of puberty, and above the pudendum, even in females, the masculine genitals appear in some, conspicuous in all their three forms, one resembling the viretram or yard, the other like the two testicles: but for the most part it happens, that of the two instruments of generation one is feeble and inert; and it is extremely rare that both are found sufficiently valid and proper for feats of love; nay, even in a great many, both these members are deficient and impotent, so that they can perform the office neither of a male nor of a female."

With respect to them, it appears, from a collation of all the circumstances which have been observed by naturalists worthy of credit, that there is no such thing as a perfect androgyne, or real hermaphrodite; that is to say, a living creature which, by its unnatural or rather preternatural structure, possesses the genuine powers of both sexes, in such a manner as to be qualified for performing the functions of either with success: the irregularity of their fabrication almost always consists in something superfluous added to one of the two sexes, which gives it the appearance of the other, without bestowing the real and characteristical distinction; and every hermaphrodite is always a very woman. Since this monstrous exhibition of nature is not such as to abrogate the rights or destroy the character of humanity amongst human beings, this involuntary misfortune implies no right to deprive those upon whom it is inflicted by nature of the privileges natural to every citizen; and, as this deficiency is no more infectious than any other corporeal mutilation, it is not easy to see why marriage should be prohibited to one of these unhappy beings, merely on account of its equivocal appearance, which acts in the character of its prevailing sex. If such a creature, by the defect of its construction, should be barren; this does not infer any right of dissolving the marriage which it may have contracted, more than the same sterility proceeding from any cause whether known nor unknown, if his or her consort should not on that account require a divorce. It is only the licentious abuse either of one or the other sex which can be subjected to the animadversion of the police.

Such are the sentiments of the authors of the French Encyclopédie. After all, we cannot forbear to add, that from such heterogeneous matches nature seems to recoil with innate and inextinguishable horror. Nor are any of these invincible averfions implanted in our frame without a final cause worthy of its Author. We would gladly ask these free-thinking gentlemen, in cases where the sexes are so unnaturally confounded, how the police can, by its most severe rigorous animadversions, either detect or prevent those licentious abuses against which they remonstrate? Since therefore, an evil so baneful to human society could no otherwise be prevented than by the sanction of Nature against such horrible conjunctions, the instinctive antipathy which they inspire was highly worthy of her wisdom and purity.

In most species of animals, the production of hermaphrodites appears to be the effect of chance; but in the black cattle it seems to be an established principle of their propagation. It is a well-known fact, and, as far as hath yet been discovered, appears to be universal, that when a cow brings forth two calves, one of them a bull, and the other a cow to appearance, the cow is unfit for propagation, but the bull-calf becomes a very proper bull. They are known not to breed; they do not even shew the least inclination for the bull, nor does the bull ever take the least notice of them. Among the country people in England, this kind of calf is called a *free-martin*; and this singularity is just as well known among the farmers as either cow or bull. When they are preserved, it is for the purposes of an ox or spayed heifer; viz. to yoke with the oxen, or fatten for the table. They are much larger than either the bull or the cow, and the horns grow longer and bigger, being very similar to those of an ox. The bellow of a free-martin is also familiar to that of an ox, and the meat is similar to that of the ox or spayed heifer, viz. much finer in the fibre than either the bull or cow; and they are more susceptible of growing fat with good food. By some they are supposed to exceed the ox and heifer in delicacy of taste, and bear a higher price at market; this, however, does not always hold, and Mr. Hunter gives an instance of the contrary. The Romans, who called the bull *taurus*, spoke also of *tauræ* in the feminine gender different from cows. Stephens observes, that it was thought they meant by this word *barren cows*, who obtained the name because they did not conceive any more than bulls. He also quotes a passage from Columella, lib. vi. cap. xxii. "And like the *tauræ*, which occupy the place of fertile cows, should be rejected or sent away." He likewise quotes Varro, *De Re rustica*, lib. ii. cap. v. "The cow which is barren is called *tauræ*." From which we may reasonably conjecture, that the Romans had not the idea of the circumstances of their production.

Of these creatures Mr. Hunter dissected three, and the following appearances were observed in the most perfect of them.—The external parts were rather smaller than in the cow. The vagina passed on as in the cow to the opening of the urethra, and then it begins to contract into a small canal, which passed on to the division of the uterus into the two horns; each horn passing along the edge of the broad ligament laterally towards the ovaria. At the termination of these horns were placed both the ovaria and testicles, both of which were nearly about the size of a small nutmeg. No Fallopian tubes could be found. To the testicles were vasa deferentia, but imperfect. The left one did not come near the testicle; the right only came close to it, but did not terminate in the body called *epididymis*. They were both pervious, and opened into the vagina near the opening of the urethra.—On the posterior surface of the bladder, or between the uterus and bladder, were the two bags called the *vesiculae seminales* in the male, but much smaller than what they are in the bull: the ducts opened along with the vasa deferentia.

THE ORIGIN OF SPRINGS AND FOUNTAINS.

MANY have been the conjectures of philosophers concerning the origin of springs and fountains; and great pains have been taken, both by the members of the Royal Society and those of the Academy of Sciences at Paris, to ascertain the true source of them. It was Aristotle's opinion, and held by most of the ancient philosophers after him, that the air contained in the caverns of the earth, being condensed by cold near its surface, was thereby changed into water; and that it made its way through wherever it could find a passage. But we have no experience of any such transmutation of air into water.

Those who imagine that fountains owe their origin to waters brought from the sea by subterraneous ducts, give a tolerable account how they lose their saltiness by percolation, as they pass through the earth; but find great difficulty in explaining by what power the water rises above the level of the sea, to near the tops of mountains, where springs generally abound.

It has indeed been a very popular opinion, and much espoused by Marriotte, (a diligent observer of nature,) that the rise of springs is owing to the rains and melted snow. According to him, the rain-water, which falls upon the hills and mountains, penetrating the surface, meets with clay or rocks contiguous to each other, along which it runs, till, being got a considerable distance from the top, it breaks out and forms springs.

In order however to examine this opinion, it was endeavoured to make an estimate of the quantity of rain and snow that falls in the space of a year, to see whether it would be sufficient to afford a quantity of water equal to that which is annually discharged into the sea by the rivers. The result of this enquiry was, that the quantity of rain and snow, which fell in a year into a cylindrical vessel, would fill it (if secured from evaporating) to height of about nineteen inches. Which quantity was proved insufficient to supply the rivers; for that those of England, Ireland, and Spain, discharge a greater quantity of water annually than the rain and snow, according to that experiment, is able to supply. Besides which, another observation was made at the same time, viz. that the quantity of water raised in vapour, one year with another, amounted to about thirty-two inches, which is thirteen more than falls in rain:—A plain indication, that the water of fountains is not furnished alone by rain and melted snow.

Thus the true cause of the origin of fountains remained undiscovered, till Dr. Halley, in making his celestial observations upon the tops of the mountains at St. Helena, about eight hundred yards above the level of the sea, found that the quantity of vapour, which fell there (even when the sky was clear) was so great that it very much impeded his observations, by covering his glasses with water every half-quarter of an hour; and upon that attempted to determine, by experiment, the quantity of vapour exhaled from the surface of the sea, as far as it rises from heat; in order to try whether that might be a sufficient supply for the water continually discharged by fountains. The process of his experiment was this: he took a vessel of water salted to the same degree with that of sea water, in

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which he placed a thermometer; and, by means of a pan of coals brought the water to the same degree of heat, which is observed to be that of the air in the hottest summer; this done, he fixed the vessel of water, with the thermometer in it, to one end of a pair of scales, and exactly counterpoised it with weights on the other:— Then, at the end of two hours, he found by the alteration made in the weight of the vessel, that about a sixtieth part of an inch of the depth of the water was gone off in vapour; and therefore in twelve hours one tenth of an inch would have gone off. Now this accurate observer allows the Mediterranean sea to be forty degrees long and four broad; (the broader parts compensating for the narrower, so that its whole surface is one hundred and sixty square degrees;) which, according to the experiment, must yield at least five thousand two hundred and eighty millions of tuns of water. In which account no regard is had to the winds, and the agitation of the sea; both which undoubtedly promote the evaporation.

It remained now to compare this quantity of water with that which is daily conveyed into the same sea by the rivers; the only way to do which was, to compare them with some known river; and accordingly he takes his computation from the river Thames, and, to avoid all objection, makes allowances probably greater than what were necessary.

The Mediterranean receives the following considerable rivers, viz. Iberus, the Rhone, the Tyber, the Po, the Danube, the Neister, the Borysthenes, the Tanais, and the Nile. Each of these he supposes to bring down ten times as much water as the Thames; where-by he allows for smaller rivers, which fall into the same sea. The Thames then he finds by mensuration to discharge about 10,300,000 tuns of water a day. If therefore the above nine rivers yield ten times as much water as the Thames doth, it will follow, that all of them together yield but 1827 millions of tuns in a day; which is but little more than one third of what is proved to be raised in vapour out of the Mediterranean in the same time. We have therefore from hence a source abundantly sufficient for the supply of fountains.

Now, having found that the vapour exhaled from the sea is a sufficient supply for the fountains, he proceeds in the next place to consider the manner in which they are raised, and how they are condensed into water again, and conveyed to the sources of springs.

In order to this he considers, that if an atom of water were expanded into a shell, or bubble, so as to be ten times as big in diameter as when it was water, that atom would become specifically lighter than air; and therefore would rise so long as the warmth, which first separated it from the surface of the water, should continue to distend it to the same degree; and consequently that vapours may be raised from the surface of the sea in that manner, till they arrive at a certain height in the atmosphere, at which they find the air of equal specific gravity with themselves. Here they will float, till, being condensed with cold, they become specifically heavier than the air, and fall down in dew, or being driven by the winds against the sides of mountains are compelled by the stream of air to mount up with it to the tops of them; where, being condensed into water, they presently precipitate, and, gleeing down by the crannies of the stone, part of them enters into the caverns of the hills; which being once filled, all the overplus of water that comes thither runs over by the lowest

lowest place, and, breaking out by the sides of the hills, form single springs. Many of these running down by the valleys between the ridges of the hills, and, coming to unite, form little rivulets and brooks. Others meeting in one common valley, and gaining the plain ground, being grown less rapid, become a river; and many of these, being united in one common channel, make such streams as the Rhine and Danube; which latter, he observes, one would hardly think to be a collection of water condensed out of vapour, unless we consider how vast a tract of ground that river drains, and that it is the sum of all those springs, which break out on the south side of the Carpathian mountains, and on the north side of the immense ridge of the Alps, which is a continued chain of mountains from Switzerland to the Black Sea.

Thus one part of the vapours, which are blown on to the land, is returned by the rivers into the sea, from whence it came; another part falls into the sea before it can reach the land; and this is the reason, why the rivers do not return so much water into the Mediterranean as is raised in vapour. A third part falls on the lowlands, and is the pabulum of plants, where it yet does not rest; but is again exhaled in vapour, by the action of the sun, and is either carried by the winds to the sea, to fall in rain or dew there, or else to the mountains to become the sources of springs.

However it is not to be supposed that all fountains are owing to one and the same cause; but that some proceed from rain and melted snow, which subsiding through the surface of the earth, makes its way into certain cavities, and thence issues out in the form of springs; because the waters of several are found to increase or diminish in proportion to the rain which falls: that others again, especially such as are salt, and spring near the sea-shore, owe their origin to sea-water percolated through the earth; and some to both these causes: though without doubt most of them, and particularly such as spring near the tops of high mountains, receive their waters from vapours, as before explained.

CUSTOMS AND MANNERS OF THE WELSH.—By a LADY.

THE women in general have exceeding good natural understandings, but they seem to be too well contented with the consciousness of that, for they are not solicitous to cultivate them as highly as they are capable. They love gaiety, and parties of all sorts, where cheerfulness and freedom banish restraint and formality; and their countenance is so easy and happy, that it seems to preclude all care.

In this description I do not include all the ladies of Wales; but only to say, these seem to be leading features of their natural character. I conversed with many who had not the smallest dialect, and who, to their native good humour and sweetness, added polite manners and an informed understanding. The most perfect innocence is visibly depicted in their whole deportment; and this gives such a youthfulness to their look and manner, that you may very well mistake a woman who is near thirty to be no more than eighteen. They are very pretty, have delicate complexions, and very fine teeth, and are well made; but their shape has something of the Dutch roundness and plumpness in it. The men are remarkably handsome, and in proportion to their number I think I never saw

so many any where. They, as well the women, "doff the world aside, and bid it pass." Indeed, I fear they have too much of this natural carelessness of disposition in them; for in general the Welsh gentlemen live up to the top of their fortunes, and very many far beyond them. The strongest trait in the Welsh disposition, is the most unaffected good humour: and this it is which makes them unable to withstand any temptation that comes in the form of sociability. By this means they certainly prolong the "spring," but it is sometimes followed by a long and dreary winter.

They entertain not only hospitably, but elegantly; and nothing can be so absurd in the English, as to fancy that they differ from us materially, either in their tables, their houses, or their dress. They want nothing but the last finish, that is, a high polish to be put upon their manners, and a greater desire for the attainments of the head, for in those of the heart no nation can exceed them. But, if they cannot be said to be arrived at the highest pitch of literary refinement, every one allows them to be generous and hospitable, and their style and manner perfectly expresses those inestimable qualities.

I cannot give a better trait of their excelling in these, than by relating the following fact, which happened very lately:—A young man, son of a clerk of some parish in London, and mate of a trading vessel, was engaged as sailing-master on-board the *Trimmer*, a king's cutter in Milford harbour. Being rather dissipated in his manners, he frequently resorted to Haverfordwest, where he contracted a debt of seventeen pounds, at an ordinary inn. When the landlady, who was a widow, demanded payment, a dispute arose about the charge. The consequence was a law-suit, the expences of which swelled the original debt to forty pounds; and, as the young man had not wherewithal to discharge this demand upon him, he was thrown into goal. When he had been there some little time, he broke out, in company with a deserter who was confined in the same prison, but he was soon retaken. Such was the humanity of the inhabitants of the place, that during the whole of his confinement he was amply supplied with provisions and money from some family or other. Indeed, it frequently happened, that he received two hot dinners from different families in the same day. He had not been long confined, when the inhabitants of the town entered into a subscription, and discharged the debt to the widow. The expences of the law-suit were in a great measure given up by the attorney. I am afraid this generous disposition of theirs is sometimes abused by men of desperate fortunes, who come hither from Ireland and other places, as to a place of temporary retreat, and in the character of gentleman contract debts, and then decamp.

I will not deny that the Welsh are tinctured with what is called their native warmth of temper. For if, by any inadvertent or ill-timed observation, you reflect upon either their country or their manners, they are on fire in an instant: but even this heat may be as suddenly extinguished as it was kindled. The least concession on your part, or acknowledgement that you have wronged them, and are sorry for it, will restore their wonted good humour, and their face again resumes its natural tranquillity. I verily believe, they have not the smallest particle of resentment in their whole composition. Who then would wish to rob them of their harmless jealousy of the honour

honour of their native land, and particularly since it is a land that charms every body? Happy, thrice happy, would it be, for those Welsh gentlemen who have spent their patrimony in imitating English follies, and English extravagance, had they retained a little more of their national prejudices, and set a proper value on those charming woods, mountains, and rivers, where fertility unites with commerce to bring to their very gates, all that is useful and valuable in life.

The ignorance, poverty, and meanness, of the Welsh clergy, are frequent topics of conversation in England. What they may be in other parts of Wales I cannot pretend to say; but in this place, and in all others that I have seen in this country, they are well-informed, well-bred, and well-provided for. They have no occasion to unite the occupations of preaching, fiddling at fairs, or mending shoes; nor could they do it, if it were necessary towards their subsistence. They have had the education of gentlemen, and have the manners that accompany it. They associate with the genteel people familiarly, and set them an example of temperance and regularity. They know how to command respect, but have none of that pride so frequently imputed to the priesthood.

There are very few, if any, common beggars in South Wales, which is a strong presumption that it is productive of a grateful soil, industrious peasants, decent pride, and contentment.

Account of a Custom remarked at Carmarthen of strewing the Graves with Flowers.

Upon going into the church-yard, your senses are on a sudden surprised and regaled with the scent of the most delicious new-blown flowers and aromatic herbs. When you look around you to discover from whence this profusion of sweets proceeds, you see several fresh graves strewn all over with these primitive and rural tokens of respect and regard. This tribute is always paid by some near and dear relation of the deceased, who rises very early on a Sunday morning, and, unobserved, distributes these frail yet certain marks of an unfeigned affection. A twelvemonth after their relation or friend is dead, they continue this pious office.

The church-yard is never without fresh-strewn graves, owing to their continuing their attentions for so long a time. The paths too are thus primitively and profusely adorned. The contemplation of this custom gave me the most agreeable ideas, and reminded me of many a poetical description of times, when to compliment a friend or a mistress, with a wreath of flowers or a nosegay, was esteemed as great a mark of attachment, as it would be, in these vain and degenerate days, to present them with a set of jewels, or a birthday suit.

I was walking one day in the environs of Carmarthen, and, happening to cast my eyes in at a window that stood open, I saw a pretty young woman, very neatly dressed, leaning over the edge of a small coffin, with her head resting upon her arm. The coffin stood upon a table under the window, and in it was a beautiful female infant, that looked as if it was not dead, but asleep. The mother was indulging her placid grief by admiring it as it lay, and decorating the corpse with the fairest flowers she could select. She was not a little soothed and gratified at my stopping to take notice of the little angel.

Flowers

Flowers are such natural emblems of the frailty of our mortal state, that we may easily account for the origin of this practice in early times, before the invention of letters, when every one was obliged to have recourse to types to express his thoughts; and I do not wonder that it has been so long kept up by the lower classes of the Welsh, whose unadulterated manners, and affectionate dispositions, make them fond of retaining many customs that are figurative and expressive.

ANTHROPOLITES, OR HUMAN PETRIFACTIONS.

ANTHROPOLITES, is a term denoting petrifications of the human body, as those of quadrupeds are called *zoolites*.

It has been doubted whether any real human petrifications ever occur, and whether those which have been supposed such were not mere *lusus naturæ*. But the generality of naturalists best versed in this branch assure us of real anthropolites being sometimes found. And indeed, as it is universally admitted that the zoolites are frequently seen, what negative argument therefore can be brought against the existence of the others? Are not the component parts of the human body nearly similar to those of the brute creation? Consequently, correspondent matter may be subject to, and acquire, the like accidental changes, wherever the same power or causes concur to act upon either object. If the former are not so common, it may be accounted for, in some measure, by reflecting that human bodies are generally deposited in select and appropriate places; whereas the bones of animals are dispersed every where, and falling into various beds of earth, at a greater or less depth, there is more probability of their encountering the petrifying agent. Could we credit some authors who have treated on this subject, they will tell us of entire bodies and skeletons that were found petrified: one in particular, discovered at Aix en Provence anno 1583, in a rocky cliff, the cerebrum whereof, when struck against a piece of steel, produced sparks, the bones being at the same time friable. The reports of Happel and Kircher are too absurd for belief. Van Helmont's strange relations, together with those of Jean a Costa, must also be rejected as fabulous. Scheuhzer has published an engraved figure, which he calls the *Antediluvian man*: how far it is authentic, it would be rash to say. It is, however, asserted by many respectable writers on natural history, that whole skeletons petrified have been brought to light from certain old mines, which remained closed up and disused for several centuries. These indeed are acknowledged to be very rare. Yet it is a known fact, that detached parts, osteolithi, are sometimes found, especially in situations where either the water, the soil, or both, have been observed to possess a strong putrescent quality. The human vertebræ, fragments or portions of the tibia, and even the whole cranium itself, have been seen in an absolute state of petrification. Some of these are said to appear vitriolated or mineralized. As to the petrified bones of pretended giants, they are more probably real zoolites, the bones of the larger animals. All these bones are found in various states, and under different appearances. Some are only indurated; others calcined, vitriolated, or mineralised; some, again, are simply incrustated; whilst others have

been proved completely petrified. Notwithstanding what is here advanced, it may be granted that a positive *lusus natura*, in some hands, is repeatedly mistaken for a real petrification. They are, however, distinguishable at all times by an experienced naturalist; particularly by the two following rules:—First, We may determine that fossil a *lusus natura* which, on a strict examination, is observed to deviate in any material degree from the true *res analogica existens*. Secondly, By the same parity of reasoning, those fossil shells are to be esteemed certain petrifications, and genuine antediluvian *reliquiæ*, in which, on a comparison with their *analogues* collected from the sea, there appears an exact conformity in size and figure. This comparative observation will hold good for all fossils; that is, such as present themselves either under the animal or vegetable form. It is nevertheless worthy of notice, that all testaceous fossils are not petrified; since some kinds of them have been found in beds of sand, which retained their original perfect shape and quality, but at the same time they proved very brittle, indeed scarcely bearing the most gentle touch. Shells of this description are always dissoluble by acids, in contradistinction to the petrified or calcareous fossil shells, whose property it is to resist the action of such-like *menstrua*.

OF THE ANTHROPOPHAGI, OR MEN-EATERS.

THAT there have been, in almost all ages of the world, nations who have followed the barbarous practice of eating their own species, we have abundance of testimonies.

The Cyclops, the Lestrygons, and Scylla, are all represented in Homer as anthropophagi, or men-eaters; and the female phantoms, Circe and the Syrens, first bewitched with a show of pleasure, and then destroyed. This, like the other parts of Homer's poetry, had a foundation in the manner of the times preceding his own. It was still, in many places, the age spoken of by Orpheus,

When men devour'd each other like the beasts,
Gorging on human flesh.—

According to Herodotus, among the Essedonian Scythians, when a man's father died, the neighbours brought several beasts, which they killed, mixed up their flesh with that of the deceased, and made a feast. Among the Massagetæ, when any person grew old, they killed him and ate his flesh; but, if he died of sickness, they buried him, esteeming him unhappy. The same author also assures us, that several nations in the Indies killed all their old people and their sick, to feed on their flesh: he adds, that persons in health were sometimes accused of being sick, to afford a pretence for devouring them. According to Sextus Empiricus, the first laws that were made, were for the prevention of this barbarous practice, which the Greek writers represent as universal before the time of Orpheus.

Of the practice of anthropophagy in later times, we have the testimonies of all the Romish missionaries who have visited the internal parts of Africa, and even some parts of Asia. Herrera speaks of great markets in China, furnished wholly with human flesh, for the better sort of people. Marcus Paulus speaks of the like in his time, in the kingdom of Concha towards Quinsay, and

the island of Zapengit; others, of the great Java; Barbosa, of the kingdom of Siam and island of Sumatra; others, of the islands in the Gulf of Bengal, of the country of the Samogitians, &c.

The philosophers Diogenes, Chrylippus, and Zeno, followed by the whole sect of Stoics, affirmed that there was nothing unnatural in the eating of human flesh; and that it was very reasonable to use dead bodies for food, rather than to give them a prey to worms and putrefaction. In order to make the trial, however, whether there was any real repugnancy in nature to the feeding of an animal with the flesh of its own species, Leonardus Floroventius fed a hog with hog's flesh, and a dog with dog's flesh; upon which he found the bristles of the hog to fall off, and the dog to become full of ulcers.

When America was discovered, this practice was found to be almost universal, inasmuch that several authors have supposed it to be occasioned through a want of other food, or through the indolence of the people to seek for it; though others ascribe its origin to a spirit of revenge.

It appears pretty certain from Dr. Hawkesworth's Account of the Voyages to the South Seas, that the inhabitants of the island of New Zealand, a country unfurnished with the necessaries of life, eat the bodies of their enemies. It appears also to be very probable, that both the wars and anthropophagy of these savages take their rise and owe their continuance to irresistible necessity, and the dreadful alternative of destroying each other by violence, or of perishing by hunger.

Mr. Marsden also informs us, that this horrible custom is practised by the Battas, a people in the island of Sumatra. "They do not eat human flesh (says he) as a means of satisfying the cravings of nature, owing to a deficiency of other food; nor is it sought after as a gluttonous delicacy, as it would seem among the New Zealanders. The Battas eat it as a species of ceremony; as a mode of shewing their detestation of crimes, by an ignominious punishment; and as a horrid indication of revenge and insult to their unfortunate enemies. The objects of this barbarous repast are the prisoners taken in war, and offenders convicted and condemned for capital crimes. Persons of the former description may be ransomed or exchanged, for which they often wait a considerable time; and the latter suffer only when their friends cannot redeem them by the customary fine of twenty beenchangs, or eighty dollars. These are tried by the people of the tribe where the fact was committed, but cannot be executed till their own particular raja or chief has been acquainted with the sentence; who, when he acknowledges the justice of the intended punishment, sends a cloth to cover the delinquent's head, together with a large dish of salt and lemons. The unhappy object, whether prisoner of war or malefactor, is then tied to a stake: the people assembled throw their lances at him from a certain distance; and, when mortally wounded, they run up to him, as if in a transport of passion; cut pieces from the body with their knives; dip them in the dish of salt and lemon-juice; slightly broil them over a fire prepared for the purpose; and swallow the morsels with a degree of savage enthusiasm. Sometimes (I presume according to the degree of their animosity and resentment) the whole is devoured; and instances have been known, where, with barbarity still aggravated, they tear the flesh from the carcase
with

with their mouths. To such a depth of depravity may man be plunged, when neither religion nor philosophy enlighten his steps! All that can be said in extenuation of the horror of this diabolical ceremony is, that no view appears to be entertained of torturing the sufferers, of increasing or lengthening out the pangs of death: the whole fury is directed against the corse, warm indeed with the remains of life, but past sensation of pain. I have found a difference of opinion in regard to their eating the bodies of their enemies slain in battle. Some persons long resident there, and acquainted with their proceedings, assert that it is not customary; but, as one or two particular instances have been given by other people, it is just to conclude, that it sometimes takes place, though not generally. It was supposed to be with this intent that Raja Neabin maintained a long conflict for the body of Mr. Nairne, a most respectable gentleman and valuable servant of the India company, who fell in an attack upon the campong of that chief, in the year 1775."

The Scythians, Egyptians, Chinese, Indians, Phœnicians, Persians, Greeks, Romans, Arabians, Gauls, Germans, Britons, Spaniards, Negroes, and Jews, were in early times in the habit of sacrificing men without number. If it is not possible to prove that they were all anthropophagi in their state of barbarism, it is probably because that state hath preceded the records of history.

In the account of China, published by the Abbé Renaudot, it is said, that there were anthropophagi in this empire so late as the ninth century, which is hardly to be believed; yet Marc Paolo, who had never read this account written by the Arabians, relates, that the inhabitants of the provinces of Xandu and Concha eat their prisoners. The barbarity of the Chinese with respect to the infants whom they will not rear, and of whom they destroy every year throughout the empire not fewer than thirty thousand, by smothering them in tubs of hot water, or exposing them in the streets and highways, is likewise hardly to be believed, and yet it is true.

The Peruvians, who had gone before the other nations of America in civilization, did not, at the time they were first discovered, sacrifice human victims; they were content to draw from the frontal vein, or from the nose of a child, a certain portion of blood, which, being mixed with flour, was made into cakes, and distributed to all the subjects of the empire on a certain annual solemnity. This clearly proves that the Peruvians had been originally eaters of human flesh; it is, at the same time a manifest mitigation of a barbarous species of worship; their manners and habits had been in some degree softened, and religion followed the revolution in their moral character. Happy had it been for more civilized nations, that this correspondence had been carefully preserved; and that good sense in religious matters had kept pace with their advances in science, and a polish in their manners!

OF THE ORIGIN OF POSTS.

IN the early periods of society, communication between the different parts of a country is rare and difficult, individuals at a distance having little inclination or opportunity for mutual intercourse: when such communication is at any time found necessary, a special messenger

messenger must be employed. As order and civilization advance, occasions of correspondence multiply. In particular, the sovereign finds it requisite frequently to transmit orders and laws to every part of the kingdom; and for doing so he makes use of couriers or messengers, to whom he commits the charge of forwarding his dispatches. But without stations in the way, where these couriers can be certain of finding refreshment for themselves and supplies of what may be necessary for carrying them forward, the journey, however urgent and important, must always be retarded, and in many cases altogether stopped. Experience, therefore, soon pointed out the necessity of ensuring such accommodations, by erecting upon all the great roads houses or stations at convenient intervals, where the messengers might stop, as occasion required, and where too, for the greater convenience, relays of fresh horses should always be in readiness, to enable them to pursue their journey with uninterrupted dispatch. These houses or stations were with great propriety termed posts, and the messenger who made use of them a post. Though at first, it is probable, the institution was intended solely for the sovereign and the necessities of the state; yet by degrees individuals, seeing the benefit resulting from it, made use of the opportunity to carry on their own correspondence; for which they were willing to pay an allowance to the sovereign. Thus a post-office, of some kind or other, gradually came to be established in every civilized country. Without taking notice of the different means of carrying on correspondence said to have been attempted by pigeons, dogs, and other animals, we can at least trace with certainty the invention of something like regular posts as far back as the ancient Persians. Xenophon assures us, that they were invented by Cyrus on his Scythian expedition, about 500 years before Christ; that the houses at the several stations were sumptuously built, and large enough to contain a number of men and horses; and that every courier on his arrival was obliged to communicate his dispatches to the postmaster, by whom they were immediately forwarded. From the shore of the Egean sea to Susa the capital, there were, according to Herodotus, 111 stages for posts, each a day's journey distant from the preceding.

In what manner posts were established and conducted among the Greeks does not clearly appear; but from the extended commerce carried on, and the frequent communications enjoyed among the different states, there can be no doubt that a regular conveyance, in some form or other, was established.

Though posts were well known among the Romans, yet it is difficult to trace with certainty the period of their introduction. Some writers carry it back to the times of the republic; posts and post-offices, under the names of *statores* and *stationes*, having been then, it is said, established by the senate. Whether this was the case or not, Suetonius assures us that Augustus instituted posts along all the great roads of the empire. At first the dispatches were conveyed from post to post by young men who ran on foot, and delivered the dispatch to others at the next stage. By and by Augustus substituted, in room of these, horses and chariots, both for the conveyance of dispatches and the convenience of travelling. His successors continued the same establishment; to the maintenance of which every subject of the empire was obliged to contribute.

Post-horses are mentioned in the Theodorian code *de cursu publico*; but these were only the public horses appointed to be kept there for the use of the public messengers, who before this institution seized any that came in their way. At each post station, according to Procopius, ten horses and as many postillions were kept, and the usual rate of their travelling was from five to eight stations a day.

It is to be observed, however, that all these establishments of posts in ancient times were formed as much, if not more, for travelling stations, than for the mere conveyance of letters and dispatches. This latter object, it is true, was thereby secured; but the epistolary correspondence of antiquity was probably at no time so extensive as to require or maintain post-offices on the footing of modern posts, for the mere conveyance of letters. It is in later times only, when the extension of commerce, and diffusion of literature, gave occasion to frequent communication, that these establishments are to be looked for.

The earliest institution of posts that occurs in modern history is about the year 807 by the emperor Charlemagne; who, having reduced under his dominion Italy, Germany, and a part of Spain, established three public posts at the public expence, to carry on the communication with these three provinces. The institution of posts, however, like many other institutions of that emperor, dropped at his death, and for a considerable time afterwards no traces of any such establishment are to be found. We cannot indeed discover them with certainty sooner than 1464, when that restless and suspicious prince Louis XI. established posts in France, that he might be the sooner advertised of all that passed in his own or the neighbouring kingdoms. He employed in this service 230 couriers, who delivered the letters at the different stations, and in the various towns through which they passed in their course. Succeeding monarchs created at different times certain offices for the express purpose of superintending the posts; but the frequent changes to which these offices were exposed, prevented for a long time the establishment of any regular system of posts in that kingdom; insomuch that in 1619 the author of the life of the Duke d'Epemon says the packet or letter-office was not yet set up in France. Former establishments, it is probable, were solely for the use of the court, not for the general good of the nation. From France the institution gradually spread through several other parts of Europe. In Germany, Lewis Horning assures us they were first introduced by Count Taxis, who settled them at his own expence; in acknowledgment for which the emperor Matthias in 1616 gave as a fief the office of postmaster to him and his descendants.

In England, the establishment of posts in some form or other appears as early as the reign of Edward III. but the notices concerning them are so vague, that no account can be given of them. In the reign of Edward the VI. however, some species of posts must have been set up, as an act of parliament passed in 1548, fixing the rate of post-horses at one penny per mile. The post-horses here referred to were, it is probable, chiefly for travelling, and the carriage of letters or packets only an occasional service. In 1581, we find in Camden's Annals mention made of a chief postmaster for England being appointed.—How his office was managed, does not clearly appear; the limited state of the correspondence of the country

country probably rendered it of trifling consequence. King James I. originally erected a post-office, under the controul of one Matthew de Quefter, or de l'Equefter, for the conveyance of letters to and from foreign parts; whose office was afterwards claimed by Lord Stanhope; but was confirmed and continued to William Frizel and Thomas Witherings, by King Charles I. in 1632. Previous to this time, it would appear that private persons were in use to convey letters to and from foreign parts; all such interference with the postmaster's office is therefore expressly prohibited. King Charles, in 1635, erected a letter-office for England and Scotland, under the direction of the same Thomas Witherings. The rates of postage then established were, two-pence for every single letter for a distance under 80 miles; four-pence from 80 to 140 miles; six-pence above 140 miles. The allowance to the postmasters on the road for horses employed in these posts was fixed at two-pence halfpenny per mile for every single horse. All private inland posts were discharged at this time; and in 1637 all private foreign posts were in like manner prohibited. The posts thus established, however, extended only to a few of the principal roads; and the times of transmission were not in every case so certain as they ought to have been.

Witherings was superseded for abuses in the execution of his offices in 1640, and they were sequestered into the hands of Philip Burlamachy, to be exercised under the care and oversight of the king's principal secretary of state. On the breaking out of the civil war, great confusions and interruptions were necessarily occasioned in the conduct of the letter-office; but it was about that time that the outline of the present more extended and regular plan seems to have been conceived by Mr. Edmond Prideaux, who was afterwards appointed attorney-general to the commonwealth. He was chairman of a committee in 1642 for considering the rate of postage to be set upon inland letters; and some time after was appointed postmaster by an ordinance of both houses of parliament; in the execution of which office he first established a weekly conveyance of letters into all parts of the nation. In 1653, this revenue was farmed for 10,000*l.* for England, Scotland, and Ireland; and, after the charge of maintaining postmasters, to the amount of 7000*l.* per annum, was saved to the public. Prideaux's emoluments being considerable, the common council of London endeavoured to erect another post-office in opposition to his; but they were checked by a resolution of the house of commons, declaring that the office of postmaster is, and ought to be, in the sole power and disposal of the parliament. This office was farmed by one Maubey in 1654. In 1656 a new and regular general post-office was erected by the authority of the protector and his parliament, upon nearly the same model that has been ever since adopted, with the following rates of postage: for 80 miles distance, a single letter two-pence; for a greater distance, not out of England, three-pence; to Scotland, four-pence. By an act of parliament passed soon after the restoration in 1660, the regulations settled in 1656 were re-established, and a general post-office similar to the former, but with some improvements, was erected. In 1663 the revenue of the post-office was found to produce 21,500*l.* annually. In 1685 it was made over to the king as a branch of his private income,

come, and was then estimated at 65,000*l.* per annum. The year after the revolution the amount of the post-office revenue was 90,504*l.* 10*s.* 6*d.* At the union the produce of the English post-office was stated to be 101,101*l.* In 1711 the former establishments of separate post-offices for England and Scotland were abolished; and by the stat. 9 Anne, c. 10. one general post-office, and one post-master-general, was established for the whole united kingdom; and this postmaster was empowered to erect chief letter-offices at Edinburgh, at Dublin, at New York, and other proper places in America and the West Indies. The rates of postage were also increased at this time as follows:—In England, for all distances under 80 miles 3*d.* above 80 miles 4*d.* From London to Edinburgh 6*d.* In Scotland, under 50 miles 2*d.* from 50 to 80 miles 3*d.* above 80 miles 4*d.* In Ireland, under 40 miles 2*d.* above 40 miles 4*d.*—By the above act, all persons, except those employed by the postmaster, were strictly prohibited from conveying letters. That year the gross amount of the post-office was 111,461*l.* 17*s.* 10*d.* The nett amount, on a medium, of the three preceding years, was, in the printed report of the commissioners, for the equivalent stated to be for England, 62,000*l.* and for Scotland, 2000*l.* In 1754 the gross revenue of the post-office for Great Britain amounted to 210,663*l.* in 1764 to 281,535*l.* and in 1774 to 345,321*l.*—The privilege of franking letters had been enjoyed by members of parliament from the first erection of the post-office; the original design of this exemption was, that they might correspond freely with their constituents on the business of the nation. By degrees the privilege came to be shamefully abused, and was carried so far, that it was not uncommon for the servants of members of parliament to procure a number of franks for the purpose of selling them; an abuse which was easily practised, as nothing more was required for a letter's passing free than the subscription of a member on the cover. To restrain these frauds, it was enacted, in 1764, that no letter should pass free unless the whole direction was of the member's writing, and his subscription annexed. Even this was found too great a latitude; and by a new regulation in 1784, no letter was permitted to go free unless the date was marked on the cover in the member's own hand-writing, and the letter put into the post-office the same day. That year the rates of postage were raised in the following proportions: an addition of 1*d.* for a single stage; 1*d.* from London to Edinburgh; 1*d.* for any distance under, and 2*d.* for any distance above, 150 miles. An addition to the revenue of 120,000*l.* was estimated to arise from these regulations and additional rates. In all the statements of duties upon postage of letters given in this account, the rates mentioned are those upon single letters, double letters pay double, treble letters treble, an ounce weight quadruple, postage; all above are charged by the weight in the same proportion.

About the year 1784, a great improvement was made in the mode of conveying the mails, upon a plan first suggested in 1782, by Mr. John Palmer. Diligences and stage-coaches, he observed, were established to every town of note in the kingdom; and he proposed that government, instead of sending the mails in the old mode, by a boy on horseback, should contract with the masters of these diligences to carry the mail, along with a guard for its protection. This plan, he shewed, could not fail to ensure much more expeditious

tious conveyance, the rate of travelling in diligences being far quicker than the rate of the post; and it was easy to carry it into execution with little additional expence, as the coach-owners would have a strong inducement to contract at a cheap rate for conveying the mail, on account of the additional recommendation to passengers their carriages would thereby acquire in point of security, regularity, and dispatch.

Though government heartily approved of this plan, and the public at large were satisfied of its utility; yet, like all new schemes, however beneficial, it met with a strong opposition; it was represented by a number of the oldest and ablest officers in the post-office, not only as impracticable, but dangerous to commerce and the revenue. Notwithstanding of this opposition, however, it was at last established, and gradually extended to many different parts of the kingdom; and, upon a fair comparison, it appeared that the revenue was improved, and the plan itself executed for 20,000*l.* per annum less than the sum first estimated by Mr. Palmer.

The present establishment of the general post-office for Great Britain, consists of two postmasters-general, a secretary, surveyor, comptroller-general, and upwards of 150 assistants and clerks for the head letter-office in London; the number of deputy postmasters and other officers through the kingdom is very considerable, but not easy to ascertain with accuracy, as it must frequently vary with the changes made in the establishment of country posts. The total expence of this branch of the revenue in 1788 was 149,029*l.* 17*s.* 2*d.* the gross produce may now be reckoned at 650,000*l.*

OF THE NATURE AND ORIGIN OF RIVERS.

RIVERS form one of the chief features of the surface of this globe, serving as voiders of all that is immediately redundant in our rains and springs, and also as boundaries and barriers, and even as highways, and in many countries as plentiful storehouses. They also fertilise our soil by laying upon our warm fields the richest mould, brought from the high mountains, where it would have remained useless for want of genial heat.

Being such interesting objects of attention, every branch acquires a proper name, and the whole acquires a sort of personal identity, of which it is frequently difficult to find the principle; for the name of the great body of waters which discharges itself into the sea is traced backwards to one of the sources, while all the contributing streams are lost, although their waters form the chief part of the collection. And sometimes the feeder in which the name is preserved is smaller than others which are united to the current, and which like a rich but ignoble alliance lose their name in that of the more illustrious family. Some rivers indeed are respectable even at their birth, coming at once in force from some great lake. Such is the Rio de la Plata, the river St. Laurence, and the mighty streams which issue in all directions from the Baical lake. But, like the sons of Adam, they are all of equal descent, and should take their name from one of the feeders of these lakes. This is indeed the case with a few, such as the Rhone, the Rhine, the Nile. These, after having
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mixed their waters with those of the lake, resume their appearance and their name at its outlet.

But in general their origin and progress, and even the features of their character, bear some resemblance to the life of man. The river springs from the earth; but its origin is in heaven. Its beginnings are insignificant, and its infancy is frivolous; it plays among the flowers of a meadow; it waters a garden, or turns a little mill. Gathering strength in its youth, it becomes wild and impetuous. Impatient of the restraints which it still meets with in the hollows among the mountains, it is restless and fretful; quick in its turnings, and unsteady in its course. Now it is a roaring cataract, tearing up and overturning whatever opposes its progress, and it shoots headlong down from a rock; then it becomes a fullen and gloomy pool, buried in the bottom of a glen. Recovering breath by repose, it again dashes along, till, tired of the uproar and mischief, it quits all that it has swept along, and leaves the opening of the valley strewed with the rejected waste. Now, quitting its retirement, it comes abroad into the world, journeying with more prudence and discretion through cultivated fields, yielding to circumstances, and winding round what would trouble it to overwhelm or remove. It passes through the populous cities and all the busy haunts of man, tendering its services on every side, and becomes the support and ornament of the country. Now increased by numerous alliances, and advanced in its course of existence, it becomes grave and stately in its motions, loves peace and quiet; and in majestic silence rolls on its mighty waters, till it is laid to rest in the vast abyss.

The philosopher, the real lover of wisdom, sees much to admire in the economy and mechanism of running waters; and there are few operations of nature which give him more opportunities of remarking the nice adjustment of the most simple means for attaining many purposes of most extensive beneficence. All mankind seem to have felt this. The heart of man is ever open (unless perverted by the habits of selfish indulgence and arrogant self-conceit) to impressions of gratitude and love. He who ascribes the religious principle (debased though it be by the humbling abuses of superstition) to the workings of fear alone, may betray the slavish meanness of his own mind, but gives a very unfair and a false picture of the hearts of his neighbours. Lucretius was but half a philosopher when he penned his often-quoted apophthegm. Indeed his own invocations shew how much the animal was blended with the sage.

We apprehend, that whoever will read with an honest and candid mind, unbiassed by licentious wishes, the accounts of the ancient superstitions, will acknowledge that the amiable emotions of the human soul have had their share in creating the numerous divinities whose worship filled up their calendars. The sun and the host of heaven have in all ages and nations been the objects of a sincere worship. Next to them, the rivers seem to have attracted the grateful acknowledgments of the inhabitants of the adjacent countries. They have everywhere been considered as a sort of tutelar divinities, and each little district, every retired valley, had its river-god, who was preferred to all others with a partial fondness. The expostulation of Naaman the Syrian, who was offended with the prophet for enjoining him to wash in the river Jordan, was the natural effusion of this attachment:—"What! (said he,) are not Abana and

Pharphat, rivers of Damascus, more excellent than all the waters of of Judæa? Might I not wash in them and be clean? So he went away wroth."

In those countries particularly, where the rural labours, and the hopes of the shepherd and the husbandman, were not so immediately connected with the approach and recess of the sun, and depended rather on what happened in a far distant country by the falls of periodical rains or the melting of collected snows, the Nile, the Ganges, the Indus, the river of Pegu, were the sensible agents of nature in procuring to the inhabitants of their fertile banks all their abundance, and they became the objects of grateful veneration. Their sources were sought out with anxious care even by conquering princes; and, when found, were universally worshipped with the most affectionate devotion. These remarkable rivers, so eminently and so palpably beneficent, preserve to this day, amidst every change of habit, and every increase of civilization and improvement, the fond adoration of the inhabitants of those fruitful countries through which they hold their stately course, and their waters are still held sacred. No progress of artificial refinement, not all the corruption of luxurious sensuality, has been able to eradicate this plant of native growth from the heart of man. The sentiment is congenial to his nature, and therefore it is universal; and we could almost appeal to the feelings of every reader, whether he does not perceive it in his own breast. Perhaps we may be mistaken in our opinion in the case of the corrupted inhabitants of the populous and busy cities, who are habituated to the fond contemplation of their own individual exertions as the sources of all their hopes. Give the shoemaker but leather and a few tools, and he defies the powers of nature to disappoint him; but the simpler inhabitants of the country, the most worthy and the most respectable part of every nation, after equal, perhaps greater, exertion both of skill and of industry, are more accustomed to resign themselves to the great ministers of Providence, and to look up to heaven for the "early and the latter rains," without which all their labours are fruitless.

—extrema per illos
Numenque excedens terris vestigia fecit.

And among the husbandmen and the shepherds of all nations and ages, we find the same fond attachment to their springs and rivulets.

*Fortunate senex, hic inter flumina nota
Et fontes sacros frigus captabis opacum,*

was the mournful ejaculation of poor Melibæus. We hardly know a river of any note in our own country whose source is not looked on with some respect.

We repeat our assertion, that this worship was the offspring of affection and gratitude, and that it is giving a very unfair and false picture of the human mind to ascribe these superstitions to the working of fear alone. These would have represented the river-gods as seated on ruins, brandishing rooted-up trees, with angry looks pouring out their sweeping torrents. But no such thing. The lively imagination of the Greeks felt, and expressed with an energy unknown to all other nations, every emotion of the human soul. They
figured

figured the Naiads as beautiful nymphs, patterns of gentleness and of elegance. They are represented as partially attached to the children of men; and their interference in human affairs is always in acts of kind assistance and protection. They resemble, in this respect, the rural deities of the northern nations, the fairies, but without their caprices and resentments. And, if we attend to the descriptions and representations of their river-gods, beings armed with power, an attribute which slavish fear never fails to couple with cruelty and vengeance, we find the same expression of affectionate trust and confidence in their kind dispositions. They are generally called by the respectable but endearing name of *father*. "*Da Tyberi pater*," says Virgil. Mr. Bruce says that the Nile at its source is called the *abay* or "*father*."---We observe this word, or its radix, blended with many names of rivers of the east; and think it probable that, when our traveller got this name from the inhabitants of the neighbourhood, they applied to the stream what is meant to express the tutelar or presiding spirit. The river-gods are always represented as venerable old men, to indicate their being coeval with the world. But it is always a *cruda viridisque senectus*, and they are never represented as oppressed with age and decrepitude. Their beards are long and flowing, their looks placid, their attitude easy, reclined on a bank, covered, as they are crowned, with never-fading sedges and bulrushes, and leaning on their urns, from which they pour out their plentiful and fertilizing streams.—Mr. Bruce's description of the sources of the Nile, and of the respect paid to the sacred waters, has not a frowning feature; and the hospitable old man, with his fair daughter Irepone, and the gentle priesthood which peopled the little village of Geesh, forms a contrast with the neighbouring Galla, (among whom a military leader was called the *lamb*, because he did not murder pregnant women,) which very distinctly paints the inspiring principle of this superstition. Pliny says, that at the source of the Clitumnus there is an ancient temple highly respected. The presence and the power of the divinity are expressed by the fates which stand in the vestibule.—Around this temple are several little chapels, each of which covers a sacred fountain; for the Clitumnus is the father of several little rivers which unite their streams with him. At some distance below the temple is a bridge which divides the sacred waters from those which are open to common use. No one must presume to set his foot in the streams above this bridge; and to step over any of them is an indignity which renders a person infamous. They can only be visited in a consecrated boat. Below the bridge we are permitted to bathe, and the place is incessantly occupied by the neighbouring villagers.

What is the cause of all this? The Clitumnus flows (near its source) through the richest pastures, through which it was carefully distributed by numberless drains; and these nourished cattle of such spotless whiteness and extraordinary beauty, that they were sought for with eagerness over all Italy, as the most acceptable victims in their sacrifices. Is not this superstition then an effusion of gratitude?

Such are the dictates of kind-hearted nature in our breasts, before it has been vitiated by vanity and self-conceit, and we should not be ashamed of feeling the impression. We hardly think of making any apology for dwelling a little on this incidental circumstance of the

superstitious veneration paid to rivers. We cannot think that our readers will be displeased at having agreeable ideas excited in their minds, being always of opinion that the torch of true philosophy will not only enlighten the understanding, but also warm and cherish the affections of the heart.

With respect to the origin of rivers, we have very little to offer in this place. It is obvious to every person, that besides the torrents which carry down into the rivers what part of the rains and melted snows is not absorbed by the soil or taken up by the plants which cover the earth, they are fed either immediately or remotely by the springs. A few remarkable streams rush at once out of the earth in force, and must be considered as the continuation of subterraneous rivers, whose origin we are therefore to seek out; and we do not know any circumstance in which their first beginnings differ from those of other rivers, which are formed by the union of little streams and rills, each of which has its own source in a spring or fountain.

Whatever be the source of rivers, it is to be met with in almost every part of the globe. The crust of earth with which the rocky framing of this globe is covered is generally stratified. Some of these strata are extremely pervious to water, having but small attraction for its particles, and being very porous. Such is the quality of gravelly strata in an eminent degree. Other strata are much more firm, or attract water more strongly, and refuse it a passage. This is the case with firm rock and with clay. When a stratum of the first kind has one of the other immediately under it, the water remains in the upper stratum, and bursts out wherever the sloping sides of the hills cut off the strata; and this will be in the form of a trickling spring, because the water in the porous stratum is greatly obstructed in its passage towards the outlet. As this irregular formation of the earth is very general, we must have springs, and of course rivers or rivulets, in every corner where there are high grounds.

Rivers flow from the higher to the low grounds. It is the arrangement of this elevation which distributes them over the surface of the earth. And this appears to be accomplished with considerable regularity; and, except the great desert of Kobi on the confines of Chinese Tartary, we do not remember any very extensive tract of ground that is deprived of those channels for voiding the superfluous waters; and even there they are far from being redundant.

The course of rivers gives us the best general method for judging of the elevation of a country. Thus it appears that Savoy and Switzerland are the highest grounds of Europe, from whence the ground slopes in every direction. From the Alps proceed the Danube and the Rhine, whose courses mark the two great valleys, into which many lateral streams descend. The Po also and the Rhone come from the same head, and with a steeper and shorter course find their way to the sea through valleys of less breadth and length. On the west side of the valleys of the Rhine and the Rhone the ground rises pretty fast, so that few tributary streams come into them from that side; and from this gentle elevation France slopes to the westward. If a line, nearly straight, but bending a little to the northward, be drawn from the head of Savoy and Switzerland all the way to Solikamskoy in Siberia, it will nearly pass through the
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most elevated part of Europe; for in this track most of the rivers have their rise. On the left go off the various feeders of the Elbe, the Oder, the Wesel, the Niemen, the Duna, the Neva, the Dwina, the Petzora. On the right, after passing the feeders of the Danube, we see the sources of the Sereth and Pruth, the Dniester, the Bog, the Dnieper, the Don, and the mighty Volga. The elevation, however, is extremely moderate; and it appears from the levels taken with the barometer by the Abbé Chappe d'Auteroche, that the head of the Volga is not more than four hundred and seventy feet above the surface of the ocean. And we may observe here by the bye, that its mouth, where it discharges its waters into the Caspian sea, is undoubtedly lower, by many feet, than the surface of the ocean. Spain and Finland, with Lapland, Norway, and Sweden, form two detached parts, which have little symmetry with the rest of Europe.

A chain of mountains begins in Nova Zembla, and stretches due south to near the Caspian sea, dividing Europe from Asia. About three or four degrees north of the Caspian sea it bends to the south-east, traverses western Tartary, and, passing between the Tengis and Zaizan lakes, it then branches to the east and south. The eastern branch runs to the shores of Korea and Kamtschatka. The southern branch traverses Turkestan and Thibet, separating them from India, and at the head of the kingdom of Ava joins an arm stretching from the great eastern branch, and here forms the centre of a very singular radiation. Chains of mountains issue from it in every direction. Three or four of them keep very close together, dividing the continent into narrow slips, which have each a great river flowing in the middle, and reaching to the extreme points of Malacca, Cambodia, and Cochin-china. From the same central point proceeds another great ridge due east, and passes a little north of Canton in China. We called this a singular centre: for, though it sends off so many branches, it is by no means the most elevated part of the continent. In the triangle which is included between the first southern ridge (which comes from between the lakes Tanges and Zaizan,) the great eastern ridge, and its branch which almost unites with the southern ridge, lies the Boutan, and part of Tibet, and the many little rivers which occupy its surface flow southward and eastward, uniting a little to the north of the centre often mentioned, and then pass through a gorge eastward into China. And it is farther to be observed, that these great ridges do not appear to be seated on the highest parts of the country; for the rivers which correspond to them are at no great distance from them, and receive their chief supplies from the other sides. This is remarkably the case with the great Oby, which runs almost parallel to the ridge from the lakes to Nova Zembla. It receives its supplies from the east, and indeed it has its source far east. The highest grounds (if we except the ridges of mountains which are boundaries) of the continent seems to be in the country of the Calmucs, about 95° east from London, and latitude 43° or 45° north. It is represented as a fine though sandy country, having many little rivers which lose themselves in the sand, or end in little salt lakes. This elevation stretches north-east to a great distance; and in this track we find the heads of the Irtysh, Selenga, and Tunguskaia, (the great feeders of Oby,) the Olenitz, the Lena, the Yana, and some other rivers, which all go off to the north.

north. On the other side we have the great river Amur, and many smaller rivers whose names are not familiar. The Hoang-ho, the great river of China, rises on the south side of the great eastern ridge we have so often mentioned. This elevation, which is a continuation of the former, is somewhat of the same complexion, being very sandy, and at present is a desert of prodigious extent. It is described, however, as interspersed with vast tracks of rich pasture; and we know that it was formerly the residence of a great nation, who came south, by the name of Turks, and possessed themselves of most of the richest kingdoms of Asia. In the south-western extremity of this country are found remains not only of barbaric magnificence, but even of cultivation and elegance. It was a profitable privilege granted by Peter the Great to some adventurers, to search these sandy deserts for remains of former opulence; and many pieces of delicate workmanship, (though not in a style which we should admire,) in gold and silver, were found. Vaults were found buried in the sand, filled with written papers, in a character wholly unknown; and a wall was discovered extending several miles, built with hewn stone, and ornamented with corniche and battlements. But we are forgetting ourselves, and return to the consideration of the distribution of the rivers on the surface of the earth. A great ridge of mountains begins at the south-east corner of the Euxine sea, and proceeds eastward, ranging along the south side of the Caspian, and still advancing unites with the mountains first mentioned in Thibet, sending off some branches to the south, which divide Persia, India, and Thibet. From the south side of this ridge flow the Euphrates, Tigris, Indus, Ganges, &c. and from the north the ancient Oxus and many unknown streams.

There is a remarkable circumstance in this quarter of the globe. Although it seems to be nearest to the greatest elevations, it seems also to have places of the greatest depression. We have already said that the Caspian sea is lower than the ocean. There is in its neighbourhood another great basin of salt-water, the lake Aral, which receives the waters of the Oxus or Gihon, which were said to have formerly run into the Caspian sea. There cannot therefore be a great difference in the level of these two basins; neither have they any outlet, though they receive great rivers. There is another great lake in the very middle of Persia, the Zare or Zara, which receives the river Hindemend, of near two hundred and fifty miles length, besides other streams. There is another such in Asia Minor. The sea of Sodom and Gomorrah is another instance. And in the high countries we mentioned, there are many small salt lakes, which receive little rivers, and have no outlet. The lake Zara in Persia, however, is the only one which indicates a considerable hollow of the country. It is now ascertained by actual survey, that the sea of Sodom is considerably higher than the Mediterranean. This feature is not, however, peculiar to Asia. It obtains also in Africa, whose rivers we now proceed to mention.

Of them, however, we know very little. The Nile indeed is perhaps better known than any river out of Europe. By the register of the weather kept by Mr. Bruce at Gondar in 1779 and 1771, it appears that the greatest rains are about the beginning of July. He says that at an average each month after June it doubles
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its rains. The calish or canal is opened at Cairo about the ninth of August, when the river has risen fourteen peeks (each twenty-one inches), and the waters begin to decrease about the tenth of September. Hence we may form a conjecture concerning the time which the water employs in coming from Abyssinia. Mr. Bruce supposes it nine days, which supposes a velocity not less than fourteen feet in a second; a thing past belief, and inconsistent with all our notions. The general slope of the river is greatly diminished by several great cataracts; and Mr. Bruce expressly says, that he might have come down from Sennaar to the cataracts of Syene in a boat, and that it is navigable for boats far above Sennaar. He came from Syene to Cairo by water. We apprehend that no boat would venture down a stream moving even six feet in a second, and none could row up if the velocity was three feet. As the waters begin to decrease about the tenth of September, we must conclude that the water then flowing past Cairo had left Abyssinia when the rains had greatly abated. Judging in this way, we must still allow the stream a velocity of more than six feet. Had the first swell at Cairo been noticed in 1770 or 1771, we might have guessed better. The year that Thevenot was in Egypt, the first swell of eight peeks was observed January 28. The calish was opened for fourteen peeks on August 14th, and the waters began to decrease on September 23d, having risen to twenty-one peeks and two thirds. We may suppose a similar progress at Cairo corresponding to Mr. Bruce's observations at Gondar, and date every thing five days earlier.

The same mountains which attract the tropical vapours, and produce the fertilizing inundations of the Nile, perform the same office to the famous Niger, whose existence has often been accounted fabulous, and with whose course we have very little acquaintance. The researches of the gentlemen of the African association render its existence no longer doubtful, and have greatly excited the public curiosity.

From the great number and the very moderate size of the rivers which fall into the Atlantic Ocean all the way south of the Gambia, we conclude that the western shore is the most elevated, and that the mountains are at no great distance inland. On the other hand, the rivers at Melinda and Sofala are of a magnitude which indicate a much longer course. But of all this we speak with much uncertainty.

The frame-work (so to call it) of America is better known, and is singular. A chain of mountains begins, or at least is found, in longitude one hundred and ten degrees west of London, and latitude forty degrees north, on the northern confines of the kingdom of Mexico, and, stretching southward through that kingdom, forms the ridge of the neck of land which separates North from South America, and, keeping almost close to the shore, ranges along the whole western coast of South America, terminating at Cape Horn. In its course it sends off branches, which, after separating from it for a few leagues, rejoin it again, inclosing valleys of great extent from north to south, and of prodigious elevation. In one of these, under the equatorial sun, stands the city of Quito, in the midst of extensive fields of barley, oats, wheat, and gardens, containing apples, pears, and gooseberries, and in short all the grains and fruits of the cooler parts of Europe; and, although the vine is also there in perfection, the olive is wanting. Not a dozen miles from it, in the low countries, the
sugar-

sugar-cane, the indigo, and all the fruits of the torrid zone, find their congenial heat, and the inhabitants swelter under a burning sun. At as small a distance on the other hand tower aloft the pinnacles of Pichincha, Corambourou, and Chemboracô, crowned with never-melting snows.

The individual mountains of this stupendous range not only exceed in height all others in the world (if we except the Peak of Teneriffe, Mount Etna, and Mount Blanc); but they are set down on a base incomparably more elevated than any other country. They cut off therefore all communication between the Pacific Ocean and the inland continent; and no rivers are to be found on the west coast of South America which have any considerable length of course or body of waters. The country is drained, like Africa, in the opposite direction. Not one hundred miles from the city of Lima, the capital of Peru, which lies almost on the sea shore, and just at the foot of the high Cordilleras, arises out of a small lake the Maragnon or Amazon's river, which, after running northward for about one hundred miles, takes an easterly direction, and crosses nearly the broadest part of South America, and falls into the great western ocean at Para, after a course of not less than three thousand five hundred miles. In the first half of its descent it receives a few middle-sized rivers from the north, and from the south it receives the great river Combos, springing from another little lake not fifty miles distant from the head of Maragnon, and inclosing between them a wide extent of country. Then it receives the Yuta, the Yuerua, the Cuchivara, and Parana Mire, each of which is equal to the Rhine; and then the Madeira, which has flowed above one thousand three hundred miles. At their junction the breadth is so great, that neither shore can be seen by a person standing up in a canoe; so that the united stream must be about six miles broad. In this majestic form it rolls along at a prodigious rate through a flat country, covered with impenetrable forests, and most of it as yet untrod by human feet. Mr. Condamine, who came down the stream, says, that all is silent as the desert, and the wild beasts and numberless birds crowd round the boat, eyeing it as some animal of which they did not seem afraid. The bed was cut deep through an equal and yielding soil, which seemed rich in every part, if he could judge by the vegetation, which was rank in the extreme. What an addition this to the possible population of this globe! A narrow slip along each bank of this mighty river would equal in surface the whole of Europe, and would probably exceed it in general fertility: and, although the velocity in the main stream was great, he observed that it was extremely moderate, nay almost still, at the sides; so that, in those parts where the country was inhabited by men, the Indians paddled up the river with perfect ease. Boats could go from Para to near the mouth of the Madeira in thirty-eight days, which is near one thousand two hundred miles.

Mr. Condamine made an observation during his passage down the Maragnon, which is extremely curious and instructive, although it puzzled him very much. He observed that the tide was sensible at a vast distance from the mouth: it was very considerable at the junction of the Madeira; and he supposes that it might have been observed much farther up. This appeared to him very surprising, because there could be no doubt but that the surface of the water there

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was higher by a great many feet than the surface of the flood of the Atlantic ocean at the mouth of the river. It was therefore very natural for him to ascribe the tide in the Maragnon to the immediate action of the moon on its waters; and this explanation was the more reasonable, because the river extends in the direction of terrestrial longitude, which by the Newtonian theory is most favourable to the production of a tide. Journeying as he did in an Indian canoe, we cannot suppose that he had much leisure or convenience for calculations, and therefore are not surprised that he did not see that even this circumstance was of little avail in so small or shallow a body of water. He carefully noted, however, the times of high and low water as he passed along. When arrived at Para, he found not only that the high water was later and later as we are farther from the mouth, but he found that at one and the same instant there were several points of high water between Para and the confluence of the Madeira, with points of low water intervening. This conclusion was easily drawn from his own observations, although he could not see at one instant the high waters in different places. He had only to compute the time of high water at a particular spot, on the day he observed it at another; allowing, as usual, for the moon's change of position. The result of his observations therefore was, that the surface of the river was not an inclined plane whose slope was lessened by the tide of flood at the mouth of the river, but that it was a waving line, and that the propagation of the tide up the river was nothing different from the propagation of any other wave. We may conceive it clearly, though imperfectly, in this way. Let the place be noted where the tide happens twelve hours later than at the mouth of the river. It is evident that there is also a tide at the very mouth at the same instant; and, since the ocean-tide had withdrawn itself during the time that the former tide had proceeded so far up the river, and the tide of ebb is successively felt above as well as the tide of flood, there must be a low water between these two high waters.

Newton had pointed out this curious fact, and observed that the tide at London-Bridge, which is forty-three feet above the sea, is not the same with that at Gravesend, but the preceding tide.

Not far from the head of the Maragnon, the Cordilleras send off a branch to the north-east, which reaches and ranges along the shore of the Mexican Gulf, and the Rio Grande de Sta Martha occupies the angle between the ridges.

Another ridge ranges with interruptions along the east coast of Terra Firma, so that the whole waters of this country are collected into the Oroonoko. In like manner the north and east of Brasil are hemmed in by mountainous ridges, through which there is no considerable passage; and, the ground sloping backwards, all the waters of this immense tract are collected from both sides by many considerable rivers into the great river Paraguay, or Rio de la Plata, which runs down the middle of this country for more than one thousand four hundred miles, and falls into the sea through a vast mouth in latitude thirty-five degrees.

Thus the whole of South America seems as if it had been formerly surrounded by a mound, and been a great basin. The ground in the middle, where the Pamara, the Madeira, and the Plata, take

their rise, is an immense marsh, uninhabitable for its exhalations, and quite impervious in its present state.

The manner in which the continent of North America is watered, or rather drained, has also some peculiarities. By looking at the map, one will observe first of all a general division of the whole of the best known part into two, by the valleys in which the beds of the river St. Laurence and Mississippi are situated. The head of this is occupied by a singular series of fresh-water seas or lakes, viz. the lake Superior and Michigan, which empty themselves into lake Huron by two cataracts. This again runs into lake Erie by the river Detroit, and the Erie pours its waters into the Ontario by the famous fall of Niagara, and from the Ontario proceeds the great river St. Laurence.

The ground to the south-west of the lakes Superior and Erie is somewhat lower, and the middle of the valley is occupied by the Mississippi and the Missoure, which receive on both sides a number of smaller streams, and, having joined, proceed to the south, under the name Mississippi. In latitude thirty-seven, this river receives into its bed the Ohio, a river of equal magnitude, and the Cherokee river, which drains all the country lying at the back of the United States, separated from them by the ranges of the Apalachian mountains. The Mississippi is now one of the chief rivers on the globe, and proceeds due south, till it falls into the Mexican bay through several shifting mouths, which greatly resemble those of the Danube and the Nile, having run above one thousand two hundred miles.

The elevated country between this bed and the Mississippi and St. Laurence and the Atlantic ocean is drained on the east side by a great number of rivers, some of which are very considerable, and of long course; because, instead of being nearly at right angles to the coast, as in other countries, they are in a great measure parallel to it. This is more remarkably the case with Hudson's river, the Delaware, Patomack, Rapahanoc, &c. Indeed the whole of North America seems to consist of ribs or beams laid nearly parallel to each other from north to south, and the rivers occupy the interstices. All those which empty themselves into the bay of Mexico are parallel and almost perfectly straight, unlike what are seen in other parts of the world. The westernmost of them all, the North River, as it is named by the Spaniards, is nearly as long as the Mississippi.

We are very little informed as yet of the distribution of rivers on the north-west coast of America, or the course of those which run into Hudson's and Baffin's bay.

The Maragnon is undoubtedly the greatest river in the world, both as to length of run and the vast body of water which it rolls along. The other great rivers succeed nearly in the following order:

Maragnon,	Riodela Plata,	Amur,	Don,
Senegal,	Yenisey,	Oroonoko,	Indus,
Nile,	Mississippi,	Ganges,	Dneiper,
St. Laurence,	Volga,	Euphrates,	Duina,
Hchang-ho,	Oby,	Danube,	&c.

We have been much assisted in this account of the course of rivers, and their distribution over the globe, by a beautiful planisphere or map of the world published by Mr. Bode astronomer royal at Berlin. The ranges of mountains are there laid down with philosophical discernment,

certainment and precision; and we recommend it to the notice of our geographers. We cannot divine what has caused Mr. Buffon to say that the course of most rivers is from east to west, or from west to east. No physical point of his system seems to require it, and it needs only that we look at his own map to see its fallacy. We should naturally expect to find the general course of rivers nearly perpendicular to the line of sea-coast; and we find it so; and the chief exceptions are in opposition to Mr. Buffon's assertion. The structure of America is so particular, that very few of its rivers have their general course in this direction.

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OF SLEEP AND DEATH.

SLEEP is rather an affection of mind than a property of body, and is therefore more naturally a subject of metaphysics than of physiology. This affection is often induced by fatigue and exercise; and several persons, when they are weary and no longer able to move their limbs, say they are exhausted. Though the word exhausted, in this expression, has seldom any precise meaning, it seems, however, to have been the means of suggesting a theory with regard to sleep. This theory supposes that sleep is occasioned by the exhaustion of irritability in the living system; but it seems to be founded on very limited and partial observations, or rather has been formed, like a great many others, prior to any observations at all, and afterwards tortured to account for facts which it does not comprehend. It does not account for the periodical returns of sleep, for the almost unremitting drowsiness of infants, and of the listless lethargic inaction so often attendant on old age. When no exhaustion of irritability can well be supposed to have taken place, the propensity to sleep on many occasions becomes irresistible, from the effects of monotonous speaking, from stillness, darkness, or from the sameness of scenery around us; and, when one stimulus, after long application, can rouse no more (a plain proof that the irritable principle is by no means exhausted), another stimulus that is less powerful in ordinary cases is accompanied with excitement.

Of these phenomena, we frankly confess that we can assign no physical cause that is satisfactory. It is easy, however, to see the intention which nature has in view by inducing sleep. It has long been observed, that in all living bodies there is a continual waste and repair, or, to speak with more precision and accuracy, one process of assimilation and another of dissolution constantly taking place in all the different parts of the system. It is also true that this assimilation, when the body is healthy, predominates in youth; that dissolution prevails in old age; and that the two are nearly on a par during the meridian of life. Another fact which admits of demonstration is, that a gentle and moderate exertion of mind and body will promote both. And lastly, it is certain that immoderate exertion in either respect, or any exertion that is not suited to our strength, habits, or period of life, prevents assimilation, hastens dissolution; and that the means which nature employs to restore the balance is usually by inducing a state of sleep.

When the balance is restored, and all the parts are again repaired for discharging their office, man awakes; but his waking period is of short duration, if appetite or passion do not engage him in some pursuit, if his mind be not occupied with some object, or if no stimuli be applied from without. This period seems chiefly intended for collecting food, and for being employed in those exertions which promote respiration, digestion, absorption, circulation, and secretion; while sleep, after the food is collected, assists nutrition, and promotes assimilation throughout the system. If what is the natural food of the species cannot be collected by the plant or animal in a short time, the period of sleep is proportionally restricted. If the food received be difficultly assimilated, the period of sleep is proportionally extended. If the food be not prepared for assimilation, the sleep is disturbed. If it be difficultly prepared by the organs, the active exertions are more vigorous; if easily prepared, they are more feeble. If it be collected during the day, the sleep is at night; if collected in the night, the sleep takes place during the day; and all living bodies are directed by nature to select that time and species of food which is most suited to their nature, their habits, their circumstances, and age.

To favour nutrition, not only the body, but even the mind, must be allowed to indulge in rest. The child sleeps, and his mental faculties are under restraint, that those functions employed in nutrition may not be disturbed. The mental faculties are still feeble in a more advanced period of life; and the moderate exertions of mind and body which are natural to youth are chiefly such as favour the preparatory organs of the system, and promote growth: but the active and vigorous exertions of manhood, considered with respect to mind or to body, soon cause dissolution to preponderate in the scale, and old age becomes listless, inactive, and drowsy, and the mind returns to childhood or dotage, because living bodies are known to accommodate themselves to circumstances, and because the prevailing dissolution is retarded by the frequent returns of rest and of sleep, which favour so much the assimilating powers, counteract re-absorption, and oppose decay.

During sleep the irritable principle is more languid, and all the senses are more obtuse. The mind then is withdrawn to its rest, and does not attend to stimuli from without. The same happens when the mind is absorbed in profound thought: but profound thought is hurtful to the system. The mind then is engaged in pursuits peculiarly its own, and less attentive to the calls of nature. In the time of sleep it withdraws seemingly, not so much for its own sake as that of the body, which then being freed from the interruption of voluntary motions, all those organs which act spontaneously can more easily discharge their functions.

For the best of reasons, the mind is not allowed to judge for itself when it is proper to eat, to drink, to sleep, to wake, and to propagate the species. These and the like are offices too important to be wholly intrusted with a being of so very limited intelligence. In all these cases, it is therefore directed by certain propensities resulting from the body in consequence of stimuli or organic structure. Being often amused with thoughts and ideas on those objects which are purely intellectual, as the notes of memory, the forms of fancy, and its own operations in the ways of reasoning; being invested with some little power in rousing, calming, and regulating, the passions, the

the desires, and appetites; and having the command of all the voluntary movements of the body; it sometimes neglects its charge of the system, destroys it sometimes by excessive indulgence, and sometimes employs it in accomplishing ends peculiarly its own. One should imagine that the mental principle in the lower animals should occasion but little disturbance to the system; yet it has been observed that geese fatten sooner in the dark than they do in light, where the mind is entertained with varieties of objects; and this circumstance will partly explain why man does not fatten so regularly as the brute, and why castration, which prevents so much anxiety and passion and exhausting efforts, assists growth and the organs of nutrition. The venereal stimulus, for this reason, is not strongly felt at a very early period of youth, nor is very troublesome in old age. In the former case it would prevent the growth of the system; in the latter it would hasten its dissolution.

The natural returns of waking and sleeping may be altered by the presence or absence of stimuli, and are curiously affected by the influence of habit. Although the commencement of one of these periods happen to be changed, the commencement of the other will continue as before. If a person be accustomed to sleep precisely at nine in the evening, and to rise again at six in the morning, though his sleep in the evening may now and then be kept off till twelve, he will waken at six; and though continued by darkness, quietness, or the like causes, till the day be advanced, it will recommence in the evening at nine. The state of physiology is such at present that we cannot assign any precise physical cause for the natural kinds of sleeping and waking, or for their regular periods of return. As for the causes which occasion morbid sleeping and waking, the reader must refer to books on pathology.

Plants too have been said to sleep. At the approach of night, many of them are observed to change their appearances very considerably, and sometimes even to such a degree as scarcely to be known for what they were before. These changes happen principally to the leaves and flowers. During the night, many leaves, according to the nature and genus of the plant, are seen to rise up, to hang down, or to fold themselves in various ways for the protection of the flowers, the buds, the fruits, or young stems; and many flowers, to escape a superabundance of moisture, to hang down their mouths towards the earth, or wrap themselves up in their calices. It was mentioned already, that these phenomena are owing to stimuli acting from without: we may add here, that most of the motions are performed at the joints where the leaves and petals articulate with the stem. A period of rest is as necessary to plants as sleep is to animals. The irritable principle cannot act long under the influence of the same stimulant, except at intervals; and the rapid growth observable in plants during the night, is a strong proof that the organs employed in assimilation had been disturbed in discharging their functions during the day, when exposed to the actions of heat and light and of other stimulants.

DEATH is the cessation and total absence of the living principle in organized bodies. It is sometimes imitated by sleep and swoon; and a state of torpor in many instances can hardly be distinguished from it. Several mosses and a few animals, as the ears of blighted wheat, the feta equina, the wheel polype, and some snails as we learn from the

the Philosophical Transactions, may be safely preserved as dried preparations, not for months only but for years; and, after irritability and sensation have been totally suspended, will return to life upon the proper application of moisture. A wheel polype was put by Fontana upon a bit of glass, and exposed during the whole summer to the noonday sun; another was exposed in a similar manner for a year and an half; and, after they were like a piece of hardened glue, were restored to the use of all their functions by a few drops of water. Wherever there is death, there must therefore be likewise a partial or general decomposition of one or more of the vital organs. This decomposition takes place naturally in some living bodies after a few hours, in some after a few days; the life of others is extended to weeks; some are vigorous for months or a season. Man has often seen more than fourscore; and the hardy oak survives the shock of two or three centuries. These observations conspire to shew that there is a certain period of existence allotted by nature to every species of living bodies. In the individual this period is sometimes abridged, and may be sometimes extended by circumstances; but yet there is a bound which it cannot pass, when the vital organs must be decomposed, and the system return to moulder with the dust. The time of incubation and the time of gestation are pretty much defined in every species, because the circumstances of the individual in these cases are generally similar; but, after emerging from the foetal state, the individuals are partly entrusted to their own organs and the chances of life, which are much varied; and hence we account for the difference of their age.

Life in general seems to be proportioned to the space occupied by that series of functions which the species is evidently destined to perform: and here sometimes the accommodating principle is singularly remarkable. As the period of decay is never seen to commence in the species till that of propagation be nearly elapsed, and as propagation in the lower tribes of plants and of animals is often the immediate harbinger of death; so many animals which have not propagated, indulged the propensity, nor became uneasy from the languor of desire, continue vigorous longer than ordinary, as if it were waiting for an opportunity to multiply their kind. It is an established fact, that all living bodies are much exhausted after performing the act of generation; and many of the inferior animals begin immediately to sicken and decay. In the vegetable kingdom, where no individual is ever the victim of desire or passion; annuals, if prevented from flowering and seeding in their proper season, will live double, and sometimes triple, the usual time, till these functions be somehow performed, and then die. But when all the organs are fully evolved and have discharged, or have continued for the usual time capable of discharging, those offices for which they were intended; dissolution commences, the assimilating organs begin gradually to lose their tone, and the re-absorbents carry off more from the different parts than what they receive in the way of nutrition: the irritable fibre then becomes rigid; the membranes and cartilages begin to ossify; the bones grow harder; the smaller vessels collapse and disappear; the parts no longer are obedient as before, to the action of stimulants; and death ensues.

Some, in order to account for this event, imagine that the body receives at first a certain portion of irritability, and continues to live
till

till that be exhausted : but this theory explains nothing ; and, without pretending to a great deal of foresight, we will venture to predict, that, for all the irritability which it has, it will not be distinguished for its longevity.

With regard to the periods by which the life, the functions, and diseases, of living bodies are so frequently regulated, and which periods may sometimes be varied, but not evaded, the most prudent language that, perhaps, can be adopted in the present state of physiological science is this of the Divine, That the God who hath formed us hath numbered our days, determined our times, and prescribed the limits of our existence.

MEMOIRS OF THE LATE MR. BAKEWELL, OF DISHLEY,
LEICESTERSHIRE.

ROBERT BAKEWELL, the most successful and celebrated experimental farmer ever known in England, was born at Dishley, in Leicestershire, about the year 1725 or 6. His grandfather and father had resided on the same estate since the beginning of the present century ; and his father, who died about the year 1760, had always the reputation of being one of the most ingenious and able farmers of his neighbourhood.

Mr. Bakewell, having conducted the Dishley farm several years before the decease of his father, began, about forty years since, that course of experiments which has procured him such extensive fame. He originally adopted a principle, *a priori*, of which all the experience of his future life evinced the propriety. Having remarked that domestic animals in general produce others possessing qualities nearly similar to their own, he conceived he had only to select, from the most valuable breeds, such as promised to return the greatest possible emolument to the breeder ; and that he should then be able, by careful attention to progressive improvements, to produce a race of sheep, or other animals, possessing a maximum of advantage.

Under the influence of this excellent notion, Mr. Bakewell made excursions into different parts of England, to inspect the various breeds, and to ascertain those which were best adapted for his purposes, and the most valuable of their kinds.

His next step was to select and purchase the best of all the sorts, wherever they could be found ; and this selection, the result of several years experience, was the original stock from which he afterwards propagated his own.

This excellent ground-work was alone fostered to its present unrivalled perfection by the persevering ingenuity and industry of Mr. Bakewell.

About the year 1760, Mr. Bakewell sold his sheep by private contract, at not more than two or three guineas each. Some time afterwards he began to let some of his rams, and for a few seasons received only fifteen shillings or a guinea apiece for them ; but, as the fame of his breed extended itself, he advanced his prices, and by the year 1770 was enabled to let some of his rams for the season at twenty-five guineas. Since that time the prices and credit of his stock have been progressively increasing, and of late years single rams have been let for the season for the enormous price of four hundred guineas and upwards.

upwards. It is a fact which has no former example, that one ram, called the two-pounder, produced in one season the sum of eight hundred guineas, independent of ewes of Mr. Bakewell's own flock, which at the same rate would have made a total, the produce of a single ram, of twelve hundred guineas!

Every branch of the agricultural art is more or less indebted to the fortunate genius and original mind of Mr. Bakewell. He directed his attention however the most successfully to the improvement of the sheep known by the name of the Dishley, or New Leicestershire; to long-horned cattle; and to strong horses of the black breed, suitable for the harness and the army. The improvement of pigs, and the cultivation of the best winter-food for cattle, had latterly engaged his attention, and he had proved himself useful to the public by introducing into practice the flooding of meadows. The race of Dishley sheep are known by the fineness of their bones and flesh, the lightness of the offal, the disposition to quietness, and consequently to mature and fatten with less food than other sheep of equal weight and value. Mr. Bakewell improved his black horses by an attention to the form which is best adapted to their use. His stallions have been let for the season for one hundred guineas and upwards. About ten years since he exhibited his famous black horse to the king and many of the nobility in the court-yard at St. James's. His long-horned cattle have been characterised by properties similar to those of his sheep, viz. for the fineness of the bone and flesh, the lightness of the offal, and the disposition to fatten. In a word, no competitor ever had the temerity to vie with him in his horses and cattle; and his sheep continue universally unrivalled, notwithstanding the competitions excited at various times by motives of interest or envy.

In this place it may be worth while to insert the following statement of the prices given at two leading auctions for stock, bred from Mr. Bakewell's. These great prices, as well as the prices which these articles always maintain, are the most indubitable proofs of the high opinion which the best and most interested judges entertain of Mr. Bakewell's merit.

The first sale which we advert to was that of Mr. Fowler, of Rollwright, in Oxfordshire. This gentleman had commenced his breeding speculations with a couple of cows, and a bull which he hired of Mr. Bakewell. After his death, one article of his live stock, the horned cattle, sold for a value equal to that of the fee-simple of his farm! Fifteen head alone of bulls and cows sold for two thousand four hundred and sixty-four pounds, or at the rate of one hundred and sixty-four pounds each!

The other auction was that of Mr. Paget, at Ibstock. Mr. Paget had been many years the intimate friend, and, in the breeding society, a very eminent and successful colleague, of Mr. Bakewell. The sale of his stock was, therefore, looked up to with much eagerness by the public. At this sale, one bull sold for the sum of four hundred guineas, (and a sixth share of the same has since been sold for two hundred,) and a two-year old heifer for eighty-four! Two hundred and eleven ewes and theaves fetched three thousand three hundred and fifteen guineas—on the average seventeen guineas each; and one lot of five ewes was sold for three hundred and ten guineas!

Such was the respect paid to Mr. Bakewell in his life-time. To conclude that he was sufficiently rewarded, would be to withhold his

his due, if we consider the money and honours that are bestowed on projects far less beneficial than his. Perhaps at some future period, the civic crown and public monuments will be awarded to such characters in preference to the more doubtful claims of the warrior and the statesman.

Mr. Bakewell, at the time of his death, was verging on his 70th year; as he never had been married, his business devolves to Mr. Honeyborn, his nephew; and it is a fortunate circumstance for the public that this gentleman possesses genius and enterprise similar to that of his predecessor. In person, Mr. Bakewell was tall, broad set, and in his latter years rather inclined to corpulence. His countenance bespoke intelligence, activity, and a high degree of benevolence. His manners were frank and pleasing, and well calculated to maintain the extensive popularity he had acquired. His domestic arrangements at Dishley were formed on a scale of hospitality to strangers, that gained him universal esteem; of the numerous visitors induced to call at his house, none ever left it without having reason to extol the liberality of its owner. Many interesting anecdotes are related of his humanity towards the various orders of animals; he continually deprecated the atrocious barbarities practised by butchers and drovers; shewing by example, on his own farm, the most pleasing instances of docility in the animals under his care. In fine, without the introduction of unmeaning panegyric, Mr. Bakewell was exactly such a character as every well-meaning man would wish to be. His vices were few, and without name; his virtues such as most men ought to imitate; and his utility was of such extensive consequence, as to be a proper object of emulation to all men.

He departed this life on Thursday, October 1, 1795, after a tedious illness, which he bore with the philosophical fortitude that ever distinguished his character.

P H E N O M E N A O F T H E S E A .

WHAT proportion the superficies of the sea bears to that of the land cannot easily be ascertained. Buffon has supposed that the surface of our globe is equally divided between land and water, and has accordingly calculated the superficies of the sea to be eighty-five millions four hundred and ninety thousand five hundred and six square miles. But it is now well known that the ocean covers much more than the half of the earth's surface. Buffon believed the existence of a vast southern continent, which Captain Cook has shewn to be visionary. It was this circumstance which misled him. According to the most accurate observations hitherto made, the surface of the sea is to the land as three to one; the ocean therefore extends over one hundred and twenty-eight millions two hundred and thirty-five thousand seven hundred and fifty-nine square miles, supposing the superficies of the whole globe to be one hundred and seventy millions, nine hundred and eighty-one thousand and twelve square miles. To ascertain the depth of the sea is still more difficult than its superficies, both on account of the numerous experiments which it would be necessary to make, and the want of proper instruments for that purpose. Beyond a certain depth the sea has hitherto been found unfathomable; and, though several methods have been contrived

trived to obviate this difficulty, none of them has completely answered the purpose. We know in general that the depth of the sea increases gradually as we leave the shore; but, if this continued beyond a certain distance, the depth of the middle of the ocean would be prodigious. Indeed the numerous islands every where scattered in the sea demonstrate the contrary, by shewing us that the bottom of the water is unequal like the land, and that, so far from uniformly sinking, it sometimes rises into lofty mountains. If the depth of the sea be in proportion to the elevation of the land, as has generally been supposed, its greatest depth will not exceed above five or six miles, for there is no mountain six miles perpendicular above the level of the sea. The sea has never been actually sounded to a greater depth than a mile and sixty-six feet; every thing beyond that therefore rests entirely upon conjecture and-analogical reasoning, which ought never to be admitted to determine a single point that can be ascertained by experiment, because, when admitted, they have too often led to false conclusions. Along the coasts, where the depth of the sea is in general well known, it has always been found proportioned to the height of the shore: when the coast is high and mountainous, the sea that washes it is deep; when, on the contrary, the coast is low, the water is shallow. Whether this analogy holds at a distance from the shore, experiments alone can determine.

To calculate the quantity of water contained in the sea, while its depth is unknown, is impossible. But if we suppose with Buffon that its medium depth is the fourth part of a mile, the ocean, if its superficies be 128,235,759 square miles, will contain 32,058,939.75 cubic miles of water.

Let us now endeavour to compute the quantity of water which is constantly discharged into the sea. For this purpose let us take a river whose velocity and quantity of water is known, the Po, for instance, which according to Riccioli is one thousand feet (or one hundred perches of Boulogne) broad, ten feet deep, and runs at the rate of four miles in an hour; consequently that river discharges into the sea two hundred thousand cubic perches of water in an hour, or four millions eight hundred thousand in a day. A cubic mile contains one hundred and twenty-five millions of cubic perches; the Po therefore will take twenty-six days to discharge a cubic mile of water into the sea. Let us now suppose, what is perhaps not very far from the truth, that the quantity of water which the sea receives from the rivers in any country is proportioned to the extent of that country. The Po from its origin to its mouth traverses a country three hundred and eighty miles long, and the rivers which fall into it on every side rise from sources about sixty miles distant from it. The Po, therefore, and the rivers which it receives, water a country of forty-five thousand six hundred square miles. Now, since the whole superficies of the dry land is about forty-two millions seven hundred and forty-five thousand two hundred and fifty-three square miles, it follows, from our supposition, that the quantity of water discharged by all the rivers in the world, in one day, is thirty-six cubic miles, and in a year thirteen thousand one hundred and forty. If therefore the sea contains thirty-two millions fifty-eight thousand nine hundred and thirty-nine cubic miles of water, it would take all the rivers in the world two thousand four hundred and thirty-nine years to discharge an equal quantity.

It may seem surprising that the sea, since it is continually receiving such an immense supply of water, does not visibly increase, and at last cover the whole earth. But our surprise will cease, if we consider that the rivers themselves are supplied from the sea, and that they do nothing more than carry back those waters which the ocean is continually lavishing upon the earth. Dr. Halley has demonstrated that the vapours raised from the sea and transported upon land are sufficient to maintain all the rivers in the world. The simplicity of this great process is astonishing: the sea not only connects distant countries, and renders it easy to transport the commodities of one nation to another, but its waters rising in the air descend in showers to fertilise the earth and nourish the vegetable kingdom, and collecting into rivers flow onwards, bringing fertility and wealth and commerce along with them, and again return to the sea to repeat the same round.

The knowledge of this process of nature might, one would think, have convinced philosophers that the proportion between sea and land continued always nearly the same. Philosophers however have formed different theories about this as well as most other subjects, maintaining on the one hand that the sea is continually encroaching on the land, and on the other that the land is constantly gaining on the sea. Both sides have supported their theories by arguments, demonstrations, and incontrovertible facts!

The height of the mountains, say the philosophers who support the encroachments of the sea, is continually diminishing; exposed to the violence of every storm, the hardest rocks must at last give way and tumble down. The rivers are continually sweeping along with them particles of earth which they deposit in the bottom of the sea. Both the depth of the ocean then and the height of the dry land must be always decreasing; the waters therefore must, unless a part of them were annihilated, spread over a greater extent of surface in proportion as these causes operate. This reasoning, convincing as it is, might be confirmed by a great number of facts: it will be sufficient however to mention one or two. In the reign of Augustus, the Isle of Wight, it is said, made a part of the main land; so that people crossed over to it at low water with cart-loads of tin; yet that island is at present separated by a channel more than half a mile wide. The Godwin sands, on the eastern shore of England, were formerly the fertile estate of Earl Godwin. Nor are the encroachments of the sea confined to Britain. In the bay of Baiæ near Naples there are remains of houses and streets still visible below the present level of the sea. The sea therefore is making continued encroachments upon the land; and the time will come, say they, when the waters will again cover the surface of the earth.

Such are the arguments of those philosophers who maintain the continual encroachments of the sea. Those who maintain the opposite theory, that the land is gradually gaining on the sea, though they pretend not to deny the facts advanced by their opponents, affirm that they are altogether insufficient to establish the hypothesis which they were brought forward to support. Though the rivers carry down particles of earth into the sea, these are either accumulated on other shores, or, collecting in the bottom of the ocean, harden into stone, which being possessed of a vegetative power rises by degrees above the surface of the sea, and forms rocks, and mountains,

and islands. The vegetative nature of stone indeed is sufficient, of itself, to convince us that the quantity of earth must be daily accumulating, and consequently that the surface of the sea is diminishing in extent. Celsius, a Swedish philosopher, has endeavoured to build this theory with more solid materials than vegetable stone. In a curious memoir, published in 1743, he asserts that the Baltic and the Atlantic, at least that part of it which washes Norway, is constantly diminishing; and he proves this by the testimony of a great many aged pilots and fishermen, who affirmed that the sea was become much shallower in many places than it had been during their youth: that many rocks formerly covered with water were now several feet above the surface of the sea: that loaded vessels used formerly to ride in many places where pinnaces and barks could now with difficulty swim. He produces instances of ancient sea-port towns now several leagues from the shore, and of anchors and wrecks of vessels found far within the country. He mentions a particular rock which one hundred and sixty-eight years before was at the bottom of the sea, but was then raised eight feet above its surface. In another place, where the water fifty years before had reached to the knee, there was then none. Several rocks, too, which during the infancy of some old pilots had been two feet under water, were then three feet above it. From all these observations M. Celsius concludes, that the water of the Baltic decreases in height four lines and an half in a year, four inches five lines in eighteen years, four feet five inches in an hundred years, and in a thousand years forty-five feet. Conscious, however, that these facts, how conclusive soever as far as relates to the Baltic, can never determine the general question, M. Celsius advances another argument in support of his theory. All that quantity of moisture, says he, which is imbibed by plants, is lost to the general mass of water, being converted into earth by the putrefaction of vegetables. This notion had been mentioned by Newton, and was adopted by Van Helmont: if granted, it follows as a consequence that the earth is continually increasing and the water diminishing in a very rapid degree.

Such are the arguments advanced in support of both theories; for it is needless to mention a notion of Linnæus, that the whole earth was formerly covered with water except a single mountain. When fairly weighed, they amount to nothing more than this, that the sea has encroached upon the land in some places, and retired in others; a conclusion which we are very willing to allow. What was advanced by those philosophers, who maintain that the sea is continually encroaching on the land, about the depth of the sea constantly diminishing, must remain a mere assertion till they prove by experiments, either that this is really the case, or that nature has no way of restoring those particles of earth which are washed down by the rivers. Nor have they any good reason to affirm that the height of the mountains is decreasing. Can a single incontrovertible instance be produced of this? Are the Alps or the Apennines, or Taurus, or Caucasus, less lofty now than they were a thousand years ago? We mean not to deny that the rain actually washes down particles of earth from the mountains, nor to affirm that the hardest rocks are able to resist continual storms, nor that many mountains have suffered, and continue to suffer daily, from a thousand accidents. But the effects produced by all these causes are so trifling as to be altogether imper-

imperceptible. Nature has assiduously guarded against such accidents; she has formed the mountains of the most durable materials; and, where they are covered with earth, she has bound it together by a thick and firm matting of grass, and thus secured it from the rains; and, should accident deprive it of this covering, she takes care immediately to supply the defect. Even should the earth be swept away, together with its covering, nature has still such resources left as frequently restore things to their former state. Many kinds of moss, one would be tempted to think, have been created for this very purpose: they take root and flourish almost upon the bare rock, and furnish as they decay a sufficient bed for several of the hardy Alpine plants. These perish in their turn, and others succeed them. The roots of the plants bind fast the earth as it accumulates, more plants spring up and spread wider, till by degrees the whole surface is covered with a firm coat of grass. Even the rain, which always contains in it a good deal of earth, contributes something to hasten the process.

As the vegetation of stone, an argument advanced by the philosophers who support the opposite theory, is now, we believe, given up by all parties, it is needless to take any farther notice of it here. The hypothesis of M. Celsius, that water is converted into earth, has also shared the same fate, because it was unsupported by experiment, and contrary to every thing that we know either about earth or water. It is a little extraordinary that philosophers have been so lavish of water as to convert it in this manner into stone and earth, when they had given it, one would think, sufficient employment before in making new worlds and in confuting Moses.

As the sea covers so great a portion of the globe, we should, no doubt, by exploring its bottom, discover a vast number of interesting particulars. Unfortunately in the greater part of the ocean this has hitherto been impossible. Part, however, has been examined; and the discoveries which this examination has produced may enable us to form some idea at least of the whole. The bottom of the sea, as might have been conjectured indeed beforehand, bears a great resemblance to the surface of the dry land, being, like it, full of plains, rocks, caverns, and mountains; some of which are abrupt and almost perpendicular, while others rise with a gentle declivity, and sometimes tower above the water and form islands. Neither do the materials differ which compose the bottom of the sea and the basis of the dry land. If we dig to a considerable depth in any part of the earth, we uniformly meet with rock; the same thing holds in the sea. The strata, too, are of the same kind, disposed in the same manner, and form indeed but one whole. The same kind of mineral and bituminous substances are also found interspersed with these strata; and it is to them probably that the sea is indebted for its bitter taste. Over these natural and original strata an artificial bed has pretty generally been formed, composed of different materials in different places. It consists frequently of muddy tartareous substances firmly cemented together, sometimes of shells or coral reduced to powder, and near the mouths of rivers it is generally composed of fine sand or gravel. The bottom of the sea resembles the land likewise in another particular: many fresh springs and even rivers rise out of it, which, displacing the salt water, render the lower part of the sea wherever they abound quite fresh. An instance

of this kind occurs near Goa on the western coast of Indostan, and another in the Mediterranean sea not far from Marseilles. These facts occasioned a notion, which later experiments have exploded, that the sea beyond a certain depth was always fresh.

Substances of a very beautiful appearance are frequently brought up by the sounding-line from the bottom of the sea. The plummet is hollowed below, and this cavity filled with tallow, to which some of the substances adhere which form the bed of the ocean. These are generally sand, gravel, or mud; but they are sometimes of the brightest scarlet, vermilion, purple, or yellow; and sometimes, though less frequently, they are blue, green, or white. These colours are owing to a kind of jelly which envelopes the substances, and vanish entirely as soon as this jelly dries. At times, however, they assume the appearance of tartareous crusts, and are then so permanent, that they can be received into white wax melted and poured round them, and perhaps by proper care might be converted into valuable paints.

Sea-water is really, as any one might convince himself by pouring it into a glass, as clear and transparent as river-water. The various appearances therefore which it assumes are owing to accidental causes, and not to any change in the water itself. The depth, or the materials which compose the bottom of the sea, occasions it to assume different colours in different places. The Arabian gulph, for instance, is said to be red from the colour of the sands which form its bed. The appearance of the sea is affected too by the winds and the sun, while the clouds that pass over it communicate all their various and fleeting colours. When the sun shines it is green; when the sun gleams through a fog it is yellow; near the north pole it appears black; while in the torrid zone its colour is often brown.

The sea contains the greatest quantity of salt in the torrid zone, where otherwise from the excessive heat it would be in danger of putrefaction: as we advance northward this quantity diminishes, till at the pole it nearly vanishes altogether. Under the line Lucas found that the sea contained a seventh part of solid contents, consisting chiefly of sea-salt. At Harwich he found it yielded one-twenty-fifth of sea-salt. At Carlscroon in Sweden it contains one-thirtieth part, and on the coast of Greenland a great deal less. This deficiency of salt near the poles probably contributes a good deal towards the prodigious quantities of ice which are met with in these seas; for salt water requires a much greater degree of cold to freeze it than fresh water. It was this circumstance, probably, together with its constant motion, which induced the ancients to believe that the sea never froze. Even among the moderns it has been a generally-received opinion, that sea-ice is originally formed in rivers. Buffon has made the great quantities of ice with which the South-sea abounds an argument for the existence of a continent near the Antarctic pole. But it is now well known that great quantities of ice are formed at a distance from land. Sea-ice is of two kinds; field-ice, which extends along the shore, and is only two or three feet thick; and mountain-ice, which abounds in the middle of the ocean. The size of these mountains is sometimes prodigious. The sea-ice is always fresh, and has often been of great use to navigators. The weight of sea-water is to that of river-water as seventy-three to seventy; that is, a cubic foot of sea-water weighs seventy-three pounds, while the

the same quantity of river-water weighs only seventy pounds; but this proportion varies in different places. It is worthy of our attention, too, that the water at the surface of the sea contains less salt than near the bottom; the difference indeed is inconsiderable, but still it is something. The Compté de Marfigli found the same quantity of water, when taken from the bottom of the Mediterranean, to weigh one ounce three pennyweights fifty-one grains; whereas from the surface it weighed only one ounce three pennyweights forty-nine grains. He repeated the experiment frequently with nearly the same result.

The sea, with respect to temperature, may be divided into two regions: the first begins at the surface of the water, and descends as far as the influence of the sun's rays; the second reaches from thence to the bottom of the sea. In summer the lower region is considerably colder than the upper: but it is probable that during winter the very reverse takes place; at least the Compté de Marfigli found it so repeatedly in the Mediterranean. This naturally results from the situation of the water near the bottom of the sea. Uninfluenced by the changes in the atmosphere, it retains always nearly the same degree of temperature: and this is considerably above congelation; for the lower region of the sea, at least in the temperate parts of the world, was never known to freeze. Captain Ellis let down a sea-gage in latitude twenty-five degrees thirteen minutes north, and longitude twenty-five degrees twelve minutes west, to take the degrees of temperature and saltness of the sea at different depths. It descended five thousand three hundred and forty-six feet, which is a mile and eleven fathoms. He found the sea saltier and colder in proportion to its depth till the gage had descended three thousand nine hundred feet, when the mercury in the thermometer came up at fifty-three; but the water never grew colder, though he let down the gage two thousand four hundred and forty-six feet lower. At the surface the thermometer stood at eighty-four.

The sea has three kinds of motion: The first is that undulation which is occasioned by the wind. This motion is entirely confined to the surface; the bottom even during the most violent storms remains perfectly calm. Mr. Boyle has remarked, from the testimony of several divers, that the sea is affected by the winds only to the depth of six feet. It would follow from this, that the height of the waves above the surface does not exceed six feet; and that this holds in the Mediterranean at least, we are informed by the Compté de Marfigli, though he also sometimes observed them, during a very violent tempest, rise two feet higher.

The second kind of motion is that continual tendency which the whole water in the sea has towards the west. It is greater near the equator than about the poles; and indeed cannot be said to take place at all in the northern hemisphere beyond the tropic. It begins on the west side of America, where it is moderate: hence that part of the ocean has been called *Pacific*. As the waters advance westward, their motion is accelerated; so that, after having traversed the globe, they strike with great violence on the eastern shore of America. Being stopped by that continent, they turn northward, and run with considerable impetuosity into the gulph of Mexico; from thence they proceed along the coast of North America, till they come to the south side of the great bank of Newfoundland, when they turn

turn off, and run down through the Western Isles. This current is called the *Gulph Stream*. It was first accurately described by Dr. Franklin, who remarked also, that the water in it having been originally heated in the torrid zone, cools so gradually in its passage northward, that even the latitude might be found in any part of the stream by means of a thermometer.—This motion of the sea westward has never been explained: it seems to have some connection with the trade-winds and the diurnal revolution of the earth on its axis.

The third and most remarkable motion of the sea is the tide, which is a regular swell of the ocean once in every twelve hours, owing, as Newton has demonstrated, to the attraction of the moon. In the middle of the sea the tide seldom rises higher than one or two feet, but on the coast it frequently reaches the height of forty-five feet, and in some places even more. The tide generally rises higher in the evening than in the morning: on the coast of Britain this holds in winter, but in summer the morning tides are highest. In some seas it is said there are no tides. This cannot be owing to their being surrounded by land, because there is a tide in the lakes of North America.

The sea-air has been found salubrious and remarkably beneficial in many distempers. This may be owing to its containing a greater portion of oxygenous gas or vital air, and being less impregnated with noxious vapours, than the land. Dr. Ingenhoufz made several experiments to ascertain the salubrity of sea-air. By mixing equal measures of common air and nitrous air, he found, that at Gravesend they occupied about one hundred and four, or one measure and a four hundredth of a measure: whereas on sea, about three miles from the mouth of the Thames, two measures of air (one of common and one of nitrous air) occupied from 0.91 to 0.94. He attempted a similar experiment on the middle of the channel between the English coast and Ostend; but the motion of the ship rendered it impracticable. He found that in rainy and windy weather the sea-air contained a smaller quantity of vital air than when the weather was calm. On the sea-shore at Ostend it occupied from 94½ to 97; at Bruges he found it at 105; and at Antwerp 109½. Dr. Ingenhoufz thus concludes his paper:

It appears, from these experiments, that the air at sea and close to it is in general purer and fitter for animal life than the air on the land, though it seems to be subject to the same inconstancy in its degree of purity with that of the land; so that we may now with more confidence send our patients, labouring under consumptive disorders, to the sea, or at least to places situated close to the sea, which have no marshes in their neighbourhood. It seems also probable, that the air will be found in general much purer far from the land than near the shore, the former being never subject to be mixed with land-air.

Dr. Damman, an eminent physician and professor royal of midwifery at Ghent, told Dr. Ingenhoufz, that when he was formerly a practitioner at Ostend, during seven years, he found the people there remarkably healthy; that nothing was rarer there than to see a patient labour under a consumption or asthma, a malignant, putrid, or spotted, fever; that the disease to which they are the most subject, is a regular intermittent fever in autumn, when sudden transitions from hot to cold weather happen. People are in general very

very healthy at Gibraltar, though there are very few trees near that place; which Dr. Ingenhousz thinks is owing to the purity of the air, arising from the neighbourhood of the sea. Most small islands are very healthy, and at Malta people are little subject to diseases, and live to a very advanced age.

The saltness of sea-water is judged to arise from great multitudes both of mines and mountains of salt dispersed here and there in the depths of the sea. Dr. Halley supposes that it is probable the greatest part of the sea-salt, and of all salt lakes, as the Caspian Sea, the Dead Sea, the Lake of Mexico, and the Titicaca in Peru, is derived from the water of the rivers which they receive: and since this sort of lakes has no exit or discharge but by the exhalation of vapours, and also since these vapours are entirely fresh or devoid of such particles, it is certain that the saltness of the sea and of such lakes must from time to time increase, and therefore the saltness at this time must be greater than at any time heretofore. He further adds, that if, by experiments made in different ages, we could find the different quantity of salt which the same quantity of water (taken up in the same place, and in all other the same circumstances) would afford, it would be easy from thence, by rules of proportion, to find the age of the world very nearly, or the time wherein it has been acquiring its present saltness.

This opinion of Dr. Halley is so improbable, that it is surprising so acute a philosopher could have adopted it. That fresh-water rivers should in the course of many thousand years produce saltness in the sea, is quite incredible. If this were the case, every sea or great body of water which receives rivers must be salt, and must possess a degree of saltness in proportion to the quantity of water which the rivers discharge. But so far is this from being true, that the Palus Meotis and the great lakes in America do not contain salt but fresh water. It may indeed be objected, that the quantity of salt which the rivers carry along with them, and deposit in the sea, must depend on the nature of the soil through which they flow, which may in some places contain no salt at all: and this may be the reason why the great lakes in America and the Palus Meotis are fresh. But to this opinion, which is merely hypothetical, there are insurmountable objections. It is a curious fact that the saltness of the sea is greatest under the line, and diminishes gradually as we advance to the poles: we must therefore suppose, if Dr. Halley's theory be true, that the earth contains more salt in the tropical regions than in the temperate zones, and more in the temperate zones than in the frigid; and consequently that the rivers in these different regions contain a quantity of salt proportionable to their distance from the equator. This, however, must first be proved by experiment, and cannot be assumed as an established fact. But there is another circumstance that entirely destroys this theory. If we allow that the sea receives its saltness from the rivers, it must be equally salt or nearly so in every part of the earth. For, according to a simple and well-known principle in chemistry, when any substance is dissolved in water with the assistance of agitation, at whatever part of the water it is introduced, it will be equally diffused through the whole liquid. Now though it were true that a greater quantity of salt were introduced into the sea under the line than towards the poles, from the constant agitation occasioned by the wind

and tide, the salt must soon prevade the whole mass of water. To say that the superior degree of heat in the tropical regions may dissolve a greater quantity of salt, will not destroy our argument; for it is an established principle in chemistry, that cold water will dissolve nearly as great a quantity of salt as hot water can dissolve.

The saltiness of the sea has also been ascribed to the solution of subterraneous mines of salt which is supposed to abound in the bottom of the sea and along its shores. But this hypothesis cannot be supported. If the sea were constantly dissolving salt, it would soon become saturated; for it cannot be said that it is deprived of any part of its salt by evaporation, since rain-water is fresh. If the sea were to become saturated, neither fishes nor vegetables could live in it. We must therefore despair of being able to account for the saltiness of the sea by second causes; and must suppose that it has been salt from the creation. It is impossible indeed to suppose that the waters of the sea were at any period fresh since the formation of fishes and sea-plants: for as these will not live in water saturated with salt, neither will they live in water that is fresh; we therefore conclude that the saltiness of the sea has been nearly the same in all ages. This is the simplest hypothesis of the three that has been mentioned. It explains best the various phenomena, and is involved in fewest difficulties. We shall, however, allow that there may be some exceptions; that the saltiness of some seas, or of particular parts of the same sea, may be increased by mines of rock-salt dispersed near its shores.

With regard to the use of this salt property of sea-water, it is observed, that the saltiness of the sea preserves its waters pure and sweet; which otherwise would corrupt and stink like a filthy lake, and consequently that none of the myriads of creatures which now live therein could then have a being. From thence also the sea-water becomes much heavier, and therefore ships of greater size and quantity may be used thereon. We have a dissertation, by Dr. Russel, concerning the medical uses of sea-water in diseases of the glands, &c. wherein the author premises some observations upon the nature of sea-water, considered as impregnated with particles of all the bodies it passes over, such as submarine plants, fish, salts, minerals, &c. and saturated with their several effluvia, to enrich it and keep it from putrefaction: whence this fluid is supposed to contract a soapiness; and the whole collection, being prevaded by the sulphureous steams passing through it, to constitute what we call sea-water, the confessed distinguishing characteristics of which are saltiness, bitterness, nitrosity, and unctuousity: whence the author concludes that it may be justly expected to contribute signally to the improvement of physic. The cases in which our author informs us we are to expect advantage from sea-water are, 1. In all recent obstructions of the glands of the intestines and mesentery. 2. All recent obstructions of the pulmonary glands, and those of the viscera, which frequently produce consumptions. 3. All recent glandular swellings of the neck, or other parts. 4. Recent tumours of the joints, if they are not suppurated, or become schirrhous or cancerous, and have not carious bones for their cause. 5. Recent defluxions upon the glands of the eyelids. 6. All descædations of the skin, from an erysipelas to a lepra. 7. Diseases of the glands of the nose, with their usual companion a thickness of the lip. 8. Obstructions

obstructions of the kidneys, where there is no inflammation, and the stone not large. 9. In recent obstructions of the liver, this method will be proper where it prevents constipations of the belly, and assists other medicines directed in ictical cases. The same remedy is said to be of signal service in the bronchocele; and is likewise recommended for the prevention of those bilious colics that so frequently affect our mariners.

As it is sometimes necessary to preserve sea-water in casks for bathing and other purposes, it is of importance to know how to keep it from putrefaction. Many experiments were made to determine this point by Mr. Henry, and are recorded in the first volume of the Memoirs of the literary and philosophical Society of Manchester. His first experiment we shall here present to our readers. "To one quart of sea-water were added two scruples of fresh quicklime; to another, half an ounce of common culinary salt; and a third was kept as a standard without any addition. The mouths of the bottles being loosely covered with paper, they were exposed to the action of the sun in some of the hottest weather in summer. In about a week the standard became very offensive; and the water, with the additional quantity of salt, did not continue sweet many hours longer; whereas that with lime continued many months without ever exhibiting the least marks of putridity." When he added a drachm more of quicklime, the whole of the magnesia contained in the water was separated; and, when a further addition was made, a lime-water was immediately formed. He therefore concluded, that two scruples of quicklime are sufficient to preserve a quart of sea-water. The proportions, however, may vary a little according to the strength of the quicklime employed.

The method of making sea-water fresh is also of great importance. Many methods have been proposed for this purpose. Mr. Appleby published an account of a process which he had instituted in the year 1734. He distilled sea-water with a quantity of *lapis infernalis* and calcined bones; but this process was soon laid aside, as it was not only difficult in itself, but rendered the water unpalatable. Dr. Butler proposed soap-leys in place of Mr. Appleby's ingredients; but the water was still liable to the same objection. Dr. Stephen Hales recommended powdered chalk; but his method was expensive, and did not improve the taste of the water. Dr. Lind of Portsmouth distilled sea-water without any ingredients; but as the experiment he made was performed in a vessel containing only two quarts, with a glass receiver, in his study, nothing conclusive can be drawn from it for the use of sailors. At length Dr. Irving brought the process to a very high degree of simplicity and perfection, by which the water is obtained pure, without much expence of fuel or a complicated apparatus. For this valuable discovery he received a reward of 5000*l*. The advantages of his method may be reduced to the following: 1. The abolishing all stills, still-heads, worm-pipes, and their tubes, which occupy so much space as to render them totally incompatible with the necessary business of the ship; and using in the room of these the ship's kettle or boiler, to the top whereof may occasionally be applied a simple tube, which can easily be made on board a vessel at sea, of iron plate, stove funnel, or tin sheet; so that no situation can prevent a ship from being completely supplied with the means of distilling sea-water. 2. In consequence of the

principles of distillation being fully ascertained, the contrivance of the simplest means of obtaining the greatest quantity of distilled water, by making the tube sufficiently large to receive the whole column of vapour, and placing it nearly in an horizontal direction, to prevent any compression of the fluid, which takes place so much with the common worm. 3. The adopting the simplest and most efficacious means of condensing vapour; for nothing more is required in the distillation but keeping the surface of the tube always wet, which is done by having some sea-water at hand, and a person to dip a mop or swab into this water, and pass it along the upper surface of the tube. By this operation the vapour contained in the tube will be entirely condensed with the greatest rapidity imaginable; for by the application of the wet mop thin sheets of water are uniformly spread, and mechanically pressed upon the surface of the hot tube; which being converted into vapour make way for a succession of fresh sheets; and thus, both by the evaporation and close contact of the cold water constantly repeated, the heat is carried off more effectually than by any other method yet known. 4. The carrying on the distillation without any addition, a correct chemical analysis of sea-water having evinced the futility of mixing ingredients with it, either to prevent an acid from rising with the vapour or to destroy any bituminous oil supposed to exist in sea-water, and to contaminate the distilled water, giving it that fiery unpalatable taste inseparable from the former processes. 5. The ascertaining the proper quantity of sea-water that ought to be distilled, whereby the fresh water is prevented from contracting a noxious impregnation of metallic salts, and the vessel from being corroded and otherwise damaged by the salts caking on the bottom of it. 6. The producing a quantity of sweet and wholesome water, perfectly agreeable to the taste, and sufficient for all the purposes of shipping. 7. The taking advantage of the dressing the ship's provisions, so as to distil a very considerable quantity of water from the vapour, which would otherwise be lost, without any addition of fuel. To sum up the merits of this method in a few words: the use of a simple tube, of the most easy construction, applicable to any ship's kettle. The rejecting all ingredients; ascertaining the proportion of water to be distilled, with every advantage of quality, saving of fuel, and preservation of boilers. The obtaining fresh water, wholesome, palatable, and in sufficient quantities. Taking advantage of the vapour which ascends in the kettle while the ship's provisions are boiling. All these advantages are obtained by the above-mentioned simple addition to the common ship's kettles. But Dr. Irving proposes to introduce two farther improvements. The first is a hearth, or stove, so constructed that the fire which is kept up the whole day for the common business of the ship serves likewise for distillation; whereby a sufficient quantity of water for all the economical purposes of the ship may be obtained, with a very inconsiderable addition to the expence of fuel. The other improvement is that of substituting, even in the largest ships, cast-iron boilers, of a new construction, in the place of coppers.

As soon as sea-water is put into the boiler, the tube is to be fitted either into the top or lid, round which, if necessary, a bit of wet linen may be applied, to make it sit close to the mouth of the vessel; there will be no occasion for luting, as the tube acts like a funnel in carrying off the vapour. When the water begins to boil, the

the vapour should be allowed to pass freely for a minute, which will effectually clean the tube and upper part of the boiler. The tube is afterwards to be kept constantly wet, by passing a mop or swab, dipped in sea-water, along its upper surface. The waste water running from the mop may be carried off by means of a board made like a spout, and placed beneath the tube. The distillation may be continued till three-fourths of the water be drawn off, and no farther. This may be ascertained either by a gauge-rod put into the boiler, or by measuring the water distilled. The brine is then to be let out. Water may be distilled in the same manner while the provisions are boiling. When the tube is made on-shore, the best substance for the purpose is thin copper well tinned, this being more durable in long voyages than tin-plates. Instead of mopping, the tube, if required, may have a case made also of copper, so much larger in diameter as to admit a thin sheet of water to circulate between them by means of a spiral copper thread, with a pipe of an inch diameter at each end of the case; the lower for receiving cold water, and the upper for carrying it off when heated.

We shall now mention a different method, discovered by the Chevalier Lorgna, by congelation of sea-water. Sea-water requires a very great degree of cold in order to become ice. Our author found that a freezing mixture, made by mixing three parts of pounded ice with two parts of common salt, was quite sufficient to freeze it. The cold produced by this mixture is equal to about four degrees below nought of Fahrenheit's thermometer.

A quantity of sea-water is never entirely congealed, a portion of it always remaining fluid; and, what is very remarkable, this fluid part is incomparably more full of salt and more nauseous than the rest: hence, if this be separated from the congealed part, the latter on being melted will be found to contain much less salt than it did before congelation. This we shall call *the water of the first purification*.

If the water of the first purification be again congealed, a part of it will remain fluid as in the first operation. This fluid portion will contain a greater proportion of salt than the rest, which is of course more pure, and, being melted, forms the water of the second purification. Thus, by repeatedly freezing the same sea-water, and separating the fluid from the congealed part in every operation, it is at last perfectly purified, so as to be entirely divested of salt, and as fit for drink and other purposes as the purest water that is used.

At first the sea-water, in order to be congealed, requires a very great degree of cold, as mentioned above; the ice formed in it consists rather of scales or filaments than of a compact body, and the quantity of the fluid parts bears a considerable proportion to the quantity of ice. But as the water, by undergoing the successive congelations, becomes more and more pure, so it becomes capable of being congealed by a smaller and smaller degree of cold; the ice is at the same time more compact, and in greater quantity; the fluid part at last becoming very inconsiderable.

COMPOSITION FOR DESTROYING INSECTS.

AFTER so mild a winter, it is naturally to be expected that pleasure-grounds, lawns, nurseries, and gardens, will be much infested with caterpillars, grubs, ants, and other insects. To prevent

vent the depredations of these enemies to vegetation, the following receipt of the ingenious Mr. Tatin, which has never been known to fail, cannot but prove acceptable to our readers, at this particular season of the year.

Take of black soap, of the best quality,	1lb. $\frac{3}{4}$.
— flowers of sulphur, —	1lb. $\frac{3}{4}$.
— mushrooms, of any kind, —	2lb.
— river or rain water, —	15 gallons.

Divide the water into two equal parts; pour one part, that is to say, seven gallons and a half, into a barrel, of any convenient size, which should be used only for this purpose; let the black soap be stirred in it till it is dissolved, and then add to it the mushrooms, after they have been slightly bruised.

Let the remaining half of the water be made to boil in a kettle; put the whole quantity of sulphur into a coarse open cloth, tie it up with a packthread in form of a parcel, and fasten to it a stone or other weight, of some pounds, in order to make it sink to the bottom. If the kettle is too small for the seven gallons and a half of water to be boiled in it at once, the sulphur must also be divided. During twenty minutes (being the time the boiling should continue) stir it well with a stick, and let the packet of sulphur be squeezed, so as to make it yield to the water all its power and colour. The effect of the water is not rendered more powerful by increasing the quantity of ingredients.

The water, when taken off the fire, is to be poured into the barrel, where it is to be stirred for a short time with a stick; this stirring must be repeated every day until the mixture becomes fetid in the highest degree. Experience shews that the older, and the more fetid, the composition is, the more quick is its action. It is necessary to take care to stop the barrel well every time the mixture is stirred.

When we wish to make use of this water, we need only sprinkle it, or pour it, upon the plants, or plunge their branches into it; but the best manner of using it is to inject it upon them with a common syringe, to which is adapted a pipe of the usual construction, except that its extremity should terminate in a head of an inch and a half in diameter, pierced in the flat part with small holes, like pin-holes, for tender plants; but, for trees, a head pierced with larger holes may be made use of.

Caterpillars, beetles, bed-bugs, *aphides*, and many other insects, are killed by a single injection of this water. Insects, which live under ground, those which have a hard shell, hornets, wasps, ants, &c. require to be gently and continually injected, till the water has penetrated to the bottom of their abode. Ant-hills, particularly, require two, four, six, or eight, quarts of water, according to the size and extent of the ant-hill, which should not be disturbed till twenty-four hours after the operation. If the ants which happen to be absent should assemble, and form another hill, it must be treated in the way before mentioned. In this manner we shall at last destroy them, but they must not be too much disturbed with a stick; on the contrary, the injection should be continued till, by their not appearing upon the surface of the earth, they are supposed to be all destroyed.

We

We may advantageously add to the mixture two ounces of *rus vomica*, which should be boiled with the sulphur; the water, by this means, will acquire more power, particularly if used for destroying ants.

When all the water has been made use of, the sediment should be thrown into a hole dug in the ground, lest the poultry, or other domestic animals, should eat it.

CEREMONY OF A GENTOO WOMAN DEVOTING HERSELF ON THE FUNERAL PILE OF HER HUSBAND.

THE place fixed upon for this tragic scene, was a small islet on the bank of one of the branches of the river Cavery, about a mile to the northward of the fort of Tanjore.

When I came to the spot, I found the victim, who appeared to be not above sixteen, sitting on the ground, dressed in the Gentoo manner, with a white cloth wrapped round her, some white flowers like jessamins hanging round her neck, and some of them hanging from her hair. There were about twenty women sitting on their hams round her, holding a white handkerchief, extended horizontally over her head, to shade her from the sun, which was excessively hot, it being then about noon.

At about twenty yards from where she was sitting, and facing her, there were several Bramins busy in constructing a pile with billets of fire-wood; the pile was about eight feet long and four broad. They first began by driving some upright stakes into the ground, and then built up the middle to about the height of three feet and a half with billets of wood.

The dead husband, who, from his appearance, seemed to be sixty years of age, was lying close by, stretched out on a bier made of bamboo canes. Four Bramins walked in procession three times round the dead body, first in a direction contrary to the sun, and afterwards other three times in a direction with the sun, all the while muttering incantations; and at each round or circuit they made, they untwisted, and immediately again twisted up, the small long lock of hair which is left unshaven at the back of their heads.

Some other Bramins were in the mean time employed in sprinkling water out of a green leaf, rolled up like a cup, upon a small heap of cakes of dry cow-dung, with which the pile was afterwards to be set on fire.

An old Bramin sat at the north-east corner of the pile upon his hams, with a pair of spectacles on, reading, I suppose, the Shaster, or their scriptures, from a book composed of Cajan leaves.

Having been present now nearly an hour, I inquired when they meant to set the pile on fire: they answered, in about two hours. As this spectacle was most melancholy, and naturally struck me with horror, and as I had only gone there to assure myself of the truth of such sacrifices being made, I went away towards the fort. After I was gone about five hundred yards, they sent some one to tell me they would burn immediately; on which I returned, and found the woman had been moved from where she was sitting, to the river, where the Bramins were bathing her. On taking her out of the water they put some money in her hand, which she dipped

dipped in the river, and divided among the Bramins: she had then a yellow cloth rolled partially round her. They put some red colour, about the size of a sixpence, on the centre of her forehead, and rubbed something that appeared to me to be clay. She was then led to the pile, round which she walked three times as the sun goes; she then mounted it at the north-east corner, without any assistance, and sat herself down on the right side of her husband, who had been previously laid upon the pile. She then unscrewed the pins which fastened the jewels or silver rings on her arms; after she had taken them off, she shut them, and screwed in the pins again, and gave one to each of two women who were standing by. She unscrewed her ear-rings and other toys with great composure, and divided them among the women who were with her. There seemed to be some little squabble about the distribution of her jewels, which she settled with great precision; and then, falling gently backwards, pulled a fold of yellow cloth over her face, turned her breast towards her husband's side, and laid her right arm over his breast, and in this posture she remained without moving.

Just before she lay down, the Bramins put some rice in her lap, and also some into her mouth and on the long grey beard of her husband: they then sprinkled some water on the head, breast, and feet, of both; and tied them gently together round the middle with a slender bit of rope; they then raised as it were a little wall of wood length-ways on two sides of the pile, so as to raise it above the level of the bodies; and then put cross pieces so as to prevent the billets of wood from pressing on them: they then poured on the pile, above where the woman lay, a potful of something that appeared to me to be oil; after this they heaped on more wood, to the height of about four feet above where the bodies were built in; so that all I now saw was a stack of fire-wood.

One of the Bramins, I observed, stood at the end of the pile next the woman's head—was calling to her through the interstices of the wood, and laughed several times during the conversation. Lastly, they overspread the pile with wet straw, and tied it on with ropes.

A Bramin then took a handful of straw, which he set on fire at the little heap of burning cakes of cow-dung; and, standing to windward of the pile, he let the wind drive the flame from the straw till it caught the pile. Fortunately, at this instant, the wind rose much higher than it had been any part of the day, and in an instant the flames pervaded the whole pile, and it burnt with great fury. I listened a few seconds, but could not distinguish any shrieks, which might perhaps be owing to my being then to windward. In a very few minutes the pile became a heap of ashes.

During the whole time of this process, which lasted from first to last above two hours before we lost sight of the woman by her being built up in the middle of the pile, I kept my eyes constantly upon her; and I declare to God, that I could not perceive, either in her countenance or limbs, the least trace of either horror, fear, or even hesitation: her countenance was perfectly composed and placid; and she was not, I am positive, either intoxicated or stupified. From several circumstances, I thought the Bramins exulted in this hellish sacrifice, and did not seem at all displeased that Europeans should be witnesses of it.

CURIOUS ACCOUNT OF A PETRIFIED CITY.

THE story of a petrified city is well known all over Africa, and has been believed by many considerable persons even in Europe. Louis XIV. was so fully persuaded of its reality, that he ordered his ambassador to procure the body of a man petrified from it at any price. Dr. Shaw's account of this affair is as follows:—"About forty years ago (now more than seventy), when M. le Maire was the French consul at Tripoli, he made great inquiries, by order of the French court, into the truth of the report concerning a petrified city at Ras Sem; and, amongst other very curious accounts relating to this place, he told me a remarkable circumstance, to the great discredit, and even confutation, of all that had been so positively advanced with regard to the petrified bodies of men, children, and other animals.

"Some of the janizaries, who, in collecting tribute, traverse the district of Ras Sem, promised him, that, as an adult person would be too cumbersome, they would undertake, for a certain number of dollars, to bring him from thence the body of a little child. After a great many pretended difficulties, delays, and disappointments, they produced at length a little Cupid, which they had found, as he learned afterwards, among the ruins of Leptis; and, to conceal the deceit, they broke off the quiver, and some other of the distinguishing characteristics of that deity. However, he paid them for it, according to promise, one thousand dollars, which is about one hundred and fifty pounds sterling of our money, as a reward for their faithful service and hazardous undertaking; having run the risk, as they pretended, of being strangled if they should have been discovered in thus delivering up to an infidel one of those unfortunate Mahometans, as they take them originally to have been.

"But notwithstanding this cheat and imposition had made the consul desist from searching after the petrified bodies of men and other animals; yet there was one matter of fact, as he told me, which still very strangely embarrassed him, and even strongly engaged him in favour of current report and tradition. This was some little loaves of bread, as he called them, which had been brought to him from that place. His reasoning, indeed, thereupon, provided the pretended matter of fact had been clear and evident, was just and satisfactory; for, where we find loaves of bread, there, as he urged, some persons must have been employed in making them, as well as others for whom they were prepared. One of these loaves he had, among other petrifications, very fortunately brought with him to Cairo, where I saw it, and found it to be an echinites of the discoid kind, of the same fashion with one I had lately found and brought with me from the deserts of Marah. We may therefore reasonably conclude, that there is nothing to be found at Ras Sem, unless it be the trunks of trees, echinites, and such petrifications as have been discovered at other places.

"M. le Maire's inquiries, which we find were supported by the promise and performance of great rewards, have brought nothing farther to light. He could never learn that any traces of walls, or buildings, or animals, or utensils, were ever to be seen within the

verge of these pretended petrifications. The like account I had from a Sicilian renegado, who was the janizary that attended me whilst I was in Egypt; and, as in his earlier years he had been a soldier of Tripoli, he assured me that he had been several times at Ras Sem. This I had confirmed again in my return from the Levant by the interpreter of the British factory at Tunis, who was likewise a Sicilian renegado; and, being the libertus or freedman of the bashaw of Tripoli, was preferred by him to be the bey or viceroy of the province of Darna, where Ras Sem was immediately under his jurisdiction. His account was likewise the same; neither had he ever seen, in his frequent journeys over this district, any other petrifications than what are above mentioned. So that the petrified city, with its walls, castles, streets, shops, cattle, inhabitants, and utensils, were all of them at first the mere inventions of the Arabs, and afterwards propagated by such persons, who, like the Tripoli ambassador, and his friend above-mentioned, were credulous enough to believe them.

“However, there is one remarkable circumstance relating to Ras Sem that deserves well to be recorded. When the winds have blown away the billows of sand which frequently cover and conceal these petrifications, they discover, in some of the lower and more depressed places of this district, several little pools of water, which is usually of so ponderous a nature, that, upon drinking it, it passes through the body like quicksilver. This perhaps may be that petrifying fluid which has all along contributed to the conversion of the palm-trees and the echini into stone: for the formation not only of these, but of petrifications of all kinds, may be entirely owing to their having first of all lodged in a bed of loam, clay, sand, or some other proper nidus or matrix, and afterwards gradually been acted upon and pervaded by such a petrifying fluid as we may suppose this to be.”

To this account it may not be amiss to subjoin the memorial of Cassim Aga, the Tripoli ambassador at the court of Britain. The city, he says, is situated two days journey south from Onguela, and seventeen days journey from Tripoli by caravan to the south-east. “As one of my friends (says the ambassador) desired me to give him in writing an account of what I knew touching the petrified city, I told him what I heard from different persons, and particularly from the mouth of one man of credit who had been on the spot: that is to say, that it was a very spacious city, of a round form, having great and small streets therein, furnished with shops, with a vast castle magnificently built: that he had seen there several sorts of trees, the most part olives and palms, all of stone, and of a blue or rather lead colour: that he saw also figures of men in a posture of exercising their different employments; some holding in their hands staves, others bread, every one doing something, even women suckling their children, and in the embraces of their husbands, all of stone: that he went into the castle by three different gates, though there were many more, where he saw a man lying upon a bed of stone: that there were guards at the gates with pikes and javelins in their hands: in short, that he saw in this wonderful city many sorts of animals, as camels, oxen, horses, asses, sheep, and birds, all of stone, and the colour above-mentioned.”

The above account shews in striking colours the amazing credulity of mankind, and the avidity with which they swallow the marvellous.

HISTORY

HISTORY AND DESCRIPTION OF MOUNT ETNA.

ETNA is a famous burning mountain of Sicily, and the largest volcano in Europe. It is shaped in the form of a cone, very broad at the base, which is more than 40 miles in circumference. From the bottom you ascend ten leagues before reaching its summit on the south side; and on any of the other sides, the way being not so straight, would be considerably longer. Etna is entirely composed of substances that have been discharged from the volcano in its various explosions. It appears, from the quantities of marine bodies deposited all over the under parts of Etna, that it must have been once covered by the sea to at least one half of its present height. The whole island of Sicily, and the greatest part of mount Etna, have been, in M. Houel's opinion, formed under water. But the period when the eruptions from this volcano first commenced, the manner in which the sea subsided, and the precise time at which it fell so low as its present level on the shores of Sicily, are facts concerning of which we have no certain knowledge.

The general principle, however, may be regarded as undeniable. When this mountain stood half under water, the currents of the ocean would gradually accumulate upon it large masses, both of its own productions, such as shells, and bones of fishes, and of various other substances, which would be intermixed with the volcanic matters discharged from the focus of the burning mount. In a long series of ages these strata of heterogeneous materials would naturally become so considerable as to form the enormous mass of mountains with which the volcano is now surrounded. The currents of the ocean might often convey the volcanic matters to a considerable distance from the volcanic focus. And there are mountains at no small distance from Etna, which seem to have been produced in this manner. Those of Carlintini, at the distance of fifteen leagues, consist chiefly of a mixture of pozzolana with calcareous earths. At Lintini, and in places around it, there are distinct beds of pozzolana, scoriae, and real lava, as well as others in which all these substances are blended together in a mass of calcareous matter. At Palazzolo, about twenty-four miles from the city of Syracuse, the sides of the hills having been cut by the streams which run down them, in many places to a considerable depth, display huge masses of lava, and extensive beds of pozzolana. In the neighbourhood of Noto there are also volcanic productions to be found. And at Pachino, where the island of Sicily forms an angle, there is a range of hills extending for several miles, which consist all of pozzolana.

The province of Val de Nota is more homogeneous in the materials of which its soil consists, than the two other dales of Sicily. These, in every hill which they contain, exhibit a vast variety of different matters. So amazing, indeed, is that variety, that they may be considered as exhibiting a collection of specimens of all the different materials which enter into the composition of the globe. In those two dales few volcanic productions have been yet observed. But it is not to be inferred, for this reason, that they contain but few. They may be hereafter discovered in great plenty. In the volcano of water at Maccalubbe, between Aragona and Girginti; in the

baths of Castellamare, near Alcamo and Segeste; in the baths of Termini, in the isles of Lipari; in the hot waters of Ali, between Messina and Taormina, by the lake in the valley of Caltagirone; in all these places, which comprehend the whole circumference of Sicily, the influence of the volcano of Etna is, in some measure, felt. Nay, it would even seem, that in these places there are so many volcanic craters. All of these are so disposed as to shew that they existed prior not only to the volcanic matters, but to the other substances intermixed with them.

The waters of the sea have, in former times, risen much higher than at present. But how they retreated, or whether they are to continue stationary at their present height, we know not. For more than 2000 years, during which Sicily has been inhabited, and has had cities and harbours, the sea has not been observed either to recede or encroach in any considerable degree.

When the sea subsided from mount Etna, the mountain must have been covered over with such substances as the sea usually deposits; consequently with calcareous matters. A part of those matters would be indurated by the action of the atmosphere, while the rest would be carried down by the rain-waters, and again conveyed into the ocean. The torrents of rain-water which pour down the sides of mount Etna have furrowed its sides by cutting out for themselves channels; and they have removed from its summit, and are still removing to a farther distance, all the extraneous bodies upon it. In many places, they flow at present over a channel of lava, having cut through all the substances which lay above it: still, however, there remain in many places both calcareous matter and other marine productions, which shew that this volcano has been once covered by the waters of the ocean. But these are daily wasting away; not only the rains, but men likewise, who carry them off as materials for lime and for building, conspire to deface them.

No fewer than seventy-seven cities, towns, and villages, are scattered over the sides of Etna. They are most numerous on the south side, where the temperature of the air is milder than on the north. Reckoning those cities, towns, and villages, one with another, to contain each 1200 or 1500 souls, the whole number of the inhabitants of mount Etna will then be 92,400, or 115,500. But it is certainly much more considerable.

The lower part of the north-east side of the mountain presents to the eye very extensive plains entirely covered with lava of different thickness, on which vegetation has not yet made any progress. The nearer the shore, the more barren is the ground; while the fertility of the soil increases as we advance farther inwards. The mountain is every where full of vast excavations; which M. Houel considers as a proof, that, instead of increasing in bulk, it is actually in a state of decay and diminution. The vast torrents of lava, which overspread the sides of it from time to time, he considers as insufficient to repair the waste occasioned by rains, rivulets, and torrents flowing down from the summit. Unless the eruptions, therefore, become more frequent than they have been for some time past, he supposes, that, by degrees, the height of the mountain must be reduced to that of the surrounding bed of lava. He had not an opportunity of measuring the altitude of Etna himself; but he observes that it had been done by the celebrated M. de Saussure, who

found the elevation to be 10,036 feet. This was done on the 5th of June, 1773, at 20 minutes after seven in the morning. The height of the barometer on the most elevated part at the brink of the crater was 18 inches $11\frac{1}{2}$ lines; which, by the necessary corrections is reduced to 18 inches $10\frac{1}{2}$ lines. At the same time the mercury at Catania, placed only one foot above the level of the sea, stood at 28 inches $2\frac{1}{2}$ lines; which must be reduced to 28 inches $1\frac{1}{2}$ lines, on account of the necessary corrections for the thermometer.

From Giana M. Houel had an opportunity of contemplating the vast number of calcareous mounts scattered over that part of Etna; which he says are nothing more than fragments, the slender remains of those enormous masses which have been deposited all around the base of mount Etna; and are a very curious monument of the revolutions which this mountain has undergone. They are of a true calcareous nature; and the inhabitants are accustomed to supply themselves with limestone from them. They also use the stones of which these mounts are composed for the purposes of building; as the lava is so hard that it cannot be cut without the greatest difficulty, and they have no other stone in these parts.

Leaving this place, our author travelled over several extensive plains of lava, covered on each side of the way with stunted trees, without any cultivation; the lava being of that kind which is very unfavourable to the growth of vegetables. Arriving at St. Leonardo, he observed the course of the eruption of boiling water. This water took its course down the west side of the mountain; and the channel which it cut for itself is still visible. This eruption happened in the month of February, 1755. It was preceded by an exceedingly thick black smoke issuing from the crater, intermixed with flashes of fire. This smoke gradually became thicker, and the bursts of flame more frequent. Earthquakes and subterraneous thunder convulsed the mountain, and struck the inhabitants of the adjacent parts with the utmost terror. On Sunday, the second of March, the mountain was seen to emit a huge column of smoke exceedingly dense and black, with a dreadful noise in the bowels of the earth, accompanied also with violent flashes of lightning. From time to time there were loud cracks, like the explosions of cannon; the mountain appeared to shake from its foundations; the air on that side next Mascali became very dark, and loud peals of thunder were heard. These seemed to issue from two caverns, considerably below the summit, on the side of the mountain, and were accompanied with violent blasts of wind like a tempest.

These terrible phenomena continued and increased; Etna seemed ready to swallow up at once all those materials which it had been for so many years disgorging, or rather about to sink at once into the bowels of the earth from whence it appeared to have been elevated. The prospect was far beyond any idea that can be given by description of this tremendous scene. The inhabitants were alarmed beyond measure; the sight of the flames driven by the wind against the sides of the mountain, the shocks of the earthquake, and the fall of rocks, struck the imagination with a horror not to be conceived. During this dreadful commotion, an immense torrent of water was emitted from the highest crater of the mountain. The whole summit of Etna was at that time covered with a thick coating of snow. Through this the boiling water directed its course
eastward,

eastward, and in its passage met with frightful precipices; over these it dashed with the utmost violence, adding its tremendous roaring to the complicated horrors of this awful scene. The snow, melting instantaneously as the boiling torrent advanced, increased its destructive power by augmenting its quantity, while the mischievous effects of the heat were scarcely diminished by reason of the immense quantity of boiling liquid which continued to pour from the summit of the mountain.

This boiling torrent, having dashed its awful cataracts from one chain of rocks to another, at length reached the cultivated plains, which it overflowed for a number of miles. Here it divided itself into several branches, forming as many deep and rapid rivers; which, after several other subdivisions, discharged themselves into the sea.

Though the mountain continued to discharge water in this manner only for half an hour, the ravages of it were very terrible. Not only those of common inundations, such as tearing up trees, hurrying along rocks and large stones, took place here, but the still more dreadful effects of boiling water were felt. Every cultivated spot was laid waste, and every thing touched by it was destroyed. Even those who were placed beyond the reach of the torrent, beheld with inexpressible horror the destruction occasioned by it; and, though the alarming noises which had so long issued from the mountain now ceased in a great measure, the shocks of earthquakes, and the violent smoke which continued to issue from the mountain, shewed that the danger was not over. Two new openings were now observed, and two torrents of lava began to make their way through the snow.

On the seventh of March, a dreadful noise was again heard in the bowels of the mountain, and a new column of very thick and black smoke began to issue from it. A horrid explosion of small stones succeeded; some of which were carried as far as the hills of Mascali, and great quantities of black sand to Messina, and even quite over the strait to Reggio in Calabria. On the shifting of the wind to the northward, this sand reached as far as the plains of Agosta. Two days after the mountain opened again, and a new torrent of lava was discharged; which, however, advanced very slowly towards the plain, moving at the rate of only a mile in a day. It continued to flow in this manner for six days, when every thing appeared so quiet, that the Canon Recupero set out to view the changes which had taken place.

That gentleman's design was to trace the course of the dreadful torrent of water above-mentioned. This he was very easily enabled to do by the ravages it had made; and, by following the channel it had cut all the way from the sea to the summit of the volcano, he found that this immense quantity of water had issued from the very bowels of the mountain. After issuing from the crater, and increasing its stream by passing through and melting the snow which lay immediately below the summit, it destroyed in an instant a fine and extensive forest of fir-trees. All of these were torn up by the violence of the current, though many were no less than twenty-four or thirty inches in diameter. He observed that the great stream had, in its descent, divided itself into four branches; and these had again subdivided themselves into several smaller ones, easily distinguishable by the quantity of sand they had deposited. Afterwards reuniting

uniting their streams, they formed many islands, and rivers 900 feet in breadth, and of a depth which could not easily be determined. Proceeding farther down, and still forcing its way among the beds of old lava, the channel of the waters was widened to 1500 feet, until it was again contracted in the valleys as before. Every object which stood in the way of this tremendous torrent was moved from its place. Enormous rocks were not only hurried down, but several of them moved to more elevated situations than those they formerly occupied. Whole hills of lava had been removed and broken to pieces, and their fragments scattered along the course of the river, and the valleys were filled up by vast quantities of sand which the waters had deposited. Our author observed, that even at the time he visited the mountain, about ten years after the eruption, the whole side of it still bore the marks of this deluge.

On M. Houel's arrival at Jaci Catena, he inquired for the physician of the place; it being customary for strangers to do so who wish to learn any thing concerning the curiosities of the country, as the physicians there are generally those who have any pretensions to literature. By this guide he was shewn a well which they call Holy Water. There is a flight of steps from the surface of the ground to that of the water. The well itself is twenty feet wide and forty feet deep. It is supplied by three different springs, each of which is said to have a peculiar taste. The physician said that one of them resembled milk in its taste; and another tasted like soap; and the third had the taste of common water.

In his way to La Trizza, M. Houel discovered some very ancient baths with stoves. They had been built here on account of a spring of warm sulphureous water, supposed to be excellent for the cure of cutaneous disorders; and for which purpose they are still made use of. They are now called, the Springs of St. Venera, of whom there is an image here. The fountain from which they flow is on a level with the surface of the ground. The water tastes very disagreeably of sulphur; and deposits a quantity of white impalpable powder adhering to herbs and stones, over which it passes. This substance is termed the cream of sulphur; though it is probably a selenetic substance, formed by the decomposition of the sulphur and the union of its acid with some calcareous matter which held it in solution before.

From this place our author proceeded to the sea-port of Trizza, a small place, which with the adjacent country contains only about 300 inhabitants. Off the harbour of this place is a basaltic rock, which seems to be only the remains of a much larger one destroyed by the action of the air. All around are long ranges of basaltes, the species of which are very various.

The rocks of the Cyclops stand round the small harbour of La Trizza; and from this view we perceive a number of rocks of very different heights. All of them appear more or less above water, though some are so low that they cannot be seen without approaching very near; and this circumstance renders the harbour inaccessible to vessels of any considerable burden, at the same time that, by reason of the depth of the sea, it is impossible either to cut or unite them by a mole. The principal of these rocks is the extremity of an island, one half of which is composed of lava placed on a basaltic base; over this is a crust of pozzolano, combined with a
kind

kind of white calcareous matter of a hard and compact consistence; and which, by the action of the air, assumes the appearance of knotty porous wood. On this subject M. Houel observes, that "the rock, at some former period, had become so hard as to split, and the clefts were then filled with a very hard substance, which was porous on all sides like scoriae. That substance afterwards split also; leaving large interstices, which in their turn have been filled up with a kind of compound yellow matter. The island appeared to have been formerly inhabited, but is at present destitute both of inhabitants and of culture, only the people of La Trizza feed a few goats upon it." To the southward of the harbour of La Trizza we observe several fragments of basalt, both in form of needles and in that of prismatic columns of a very regular form, and which may be easily separated from one another. From the position in which these fragments are disposed, it appears that the mass to which they belong must have suffered some very violent shock; otherwise such huge rocks could never have been broken, overturned, and scattered in directions so very different from their original positions. In one of these ruins there are some parts harder than the rest, which withstand the action of the air, while the intervening spaces yield to it, and appear to be thus destroyed. In some others this effect is much more remarkable; because the column happens to be much farther advanced towards a state of dissolution, the parts of which they consist being already disjoined; and in each of those which project we perceive a fissure: which shews that each of these parts may be divided into two. "They are indeed actually divided, and display a convexity issuing from a concavity, like a pile of hats placed one upon another, when they are removed one by one; which is a very curious singularity."

Continuing his journey still southward, our author arrived at the promontory of the Castel d'Aci. This is the most singularly curious of all that are in the neighbourhood of Etna. The ancient mass of it is inclosed between two bodies of lava of a more modern origin. These compose the rocks on which the Castel d'Aci is situated, and which lay under the soil of the adjacent country. Beyond that city are the immense plains of the lower part of Etna. These gradually rise till they reach the summit, which is hid among the clouds. The promontory is almost entirely composed of basalt, the interstices of which are filled up with a yellowish matter, which seems to be a clay nearly of the same nature with that formerly taken notice of in the island of La Trizza. It also covers the mass of basalt, and has produced both the superior and anterior parts of the promontory. Here M. Houel saw a number of women employed in washing webs of cloth in the sea; and takes notice of the dextrous method they have of lifting it up in folds, and packing it on their heads in bundles without receiving any assistance. At the foot of this promontory are many curious basaltic rocks.

All along the eastern side of Mount Etna the soil is broken, but filled with beautiful varieties of basalt, highly worthy of observation. Indeed, there is no volcano in Europe so rich as Etna in basalt, nor where so many curious figures of it are to be seen.

M. Houel, having spent some more time in visiting the basaltic columns around the foot of the mount, set out from Aci to visit the

the famous chefnut-tree, which is known in that country by the name of *The chefnut-tree for an hundred horses*. In his way thither he passed through the villages of Fortezza, Mangamo, St. Leonardo, St. Matteo, and La Macchia. The landscapes of each of these places by itself are extremely beautiful; but the country between them is a frightful wild desert, presenting to the eye nothing but extensive plains of black lava, which at a distance have the appearance of vast quantities of pit-coal. The roads became rougher as they advanced; but the adjoining fields assumed a more smiling aspect. The reason of this is, that the torrents of lava (by which the plains are rendered unfit for vegetation for a great number of years) have rolled rapidly down the more steep sides of the mountain without destroying the fertility of the soil.

Travelling through very difficult roads, and often incommoded with dangerous precipices, our author at last arrived at the celebrated chefnut-tree, which was the chief object of this journey. He observes, that all over this side of the mountain the chefnut-trees thrive very well, and are carefully cultivated by the inhabitants. They are worked into hoops for casks, and a considerable trade is carried on in this article. The great one which he came to visit, exceeds the size of other trees so much that it cannot fail to excite the greatest admiration. It has its name from the following circumstance. Jane of Arragon spent some time in Sicily on her way from Spain to Naples.—While here, she visited Mount Etna, attended by her principal nobility; and, happening to be overtaken by a storm, they took shelter under this tree, whose branches were sufficiently extensive to cover them all.

This chefnut-tree is one hundred and sixty feet in circumference, but quite hollow within; which, however, affects not its verdure; for the chefnut-tree, like the willow, depends upon its bark for subsistence, and by age loses its internal part. As the cavity of this enormous mass is very considerable, the people have built an house in it, where they have an oven for drying nuts, almonds, and chefnuts, &c. of which they make conserves. They frequently supply themselves with wood from the tree which incircles their house, so that it seems likely, in a short time, to go to ruin through the ingratitude and thoughtlessness of its inhabitants. It has been thought that this tree was composed of a number others grown together; but our author, upon a minute examination, found it consisted of no more than one original trunk.

Besides this, there are abundance of other trees in the neighbourhood very remarkable for their size. Our traveller was shewn a number of young trees of the same species, all very beautiful and straight, and almost as smooth as polished marble. One of these was thirty-eight feet in circumference, and there were a number of others nearly of the same size. Among these there were seven standing together, which have received the name of the seven brethren. Another is denominated the ship, from the general figure of its top, which has some slight resemblance to a ship. Its diameter is twenty-five feet, so that the circumference cannot be less than seventy-five. In these extensive forests, however, there are chefnut-trees of every age and size.

M. Houel's next visit was paid to a snow grotto, being one of those magazines where that article, so necessary in the hot climate

of Sicily, is preserved for use. In his way thither he visited the forest of pines; which is so much surrounded by rocks and precipices, that it is scarcely accessible; and vast numbers of the trees are dying of old age. Some of the neighbouring peasants, however, will now and then attempt to carry them off. Our author saw one of them at this work. It was drawn by oxen, who were yoked to it by a chain connected with the beam by an iron cramp. But the extreme roughness of the road made the tree leap and bound in such a manner, that the poor creatures were every moment in danger of having their legs broken, or being hurried over precipices along with their driver; accidents which happen not unfrequently, and which render this occupation less generally practised than otherwise it would be.

The snow grotto is but lately formed by the action of the waters under the beds of lava, and carrying away the stratum of pozzolana below them. It is situated on a mount named Finocchio, which, though of very considerable size, is only a protuberance on the side of Etna. It has been repaired in the inside at the expence of the knights of Malta, who have hired this as well as several other caverns in the mountain for the purpose of holding snow, which they have still more occasion for in their island than the inhabitants of Sicily. There are two openings above, at which they throw in the snow; and flights of steps have been cut to these as well as in the internal parts. A considerable extent of ground is levelled and inclosed with high walls above the grotto; so that when the wind, which at this elevation blows with great violence, carries the snow down from the higher parts of the mountain, it is stopped and detained by the walls of this inclosure. It is then thrown into the grotto, where the thickness of the beds of lava which cover it prevents any impression from the summer-heat. When the season for exportation comes on, the snow is put into large bags, and pressed into them as close as possible. Thus it is rendered compact and heavy, and likewise runs less risk of being affected by the heat. It is then carried out upon men's shoulders, and conveyed to the shore on mules. Before it is put into the bags, the lumps of snow are carefully wrapped up in leaves, which is another preservative; at the same time that the fresh congelation of the little which melts, unites the masses so together, that the snow preserved in this manner looks like the fairest and most transparent crystal.

Our author's next excursion was to Mount Rosso, or the Red Mountain, which is one of the mouths of Etna, and through which it discharges from time to time great quantities of lava, sand, ashes, &c. It is the most celebrated of all the numerous mouths which have opened on the side of the mountain, though it has become so noted only for having poured forth the matter of the great eruption in 1669, and which is the most remarkable of any recorded in history.

When a new crater is formed on mount Etna, it is always in consequence of some shock that is powerful enough to break the arches of its caverns. Doubtless it is inconceivable that there should be any agent endowed with such force; but, when such a fracture is once made, it is necessarily very large, and the surface of the ground above cannot but be broken in several different places at considerable distances from one another. The matter which is discharged always issues from the principal opening and those adjoining to it.

None

None of these months, however, continue open, excepting that which is directly in the line in which the matter is discharged; the lava soon choking up those which are in a more oblique direction.

M. Houel went down one of these openings with torches; but could not reach the bottom, and was obliged to return on account of the extreme cold. The descent was extremely difficult, and became more so in proportion as he advanced. This crater is of an oval form, and the opening through which he descended was in one extremity: but he was tempted to think that the crater which rises above it had been formed of matter discharged by another mouth; or perhaps it might have had a more central opening, through which the stones, sand, &c. which form the crater, were discharged.

Four of the mouths of this mount appear to be composed of a reddish pozzolano, which has procured it the name of the Red Mountain; but when we ascend the pyramids, or rather funnels which they form, we find them composed of different coloured layers of sand. Some of these are of a bluish grey colour, others of a fine yellow, and some of a kind of green formed by a mixture of grey and yellow, while others are of a red colour. A great number of small crystals, black schoerls, and granites, are found among them, as well as pieces of scoria, which had been discharged by the volcano in the form of a thick and glutinous matter. All these mouths have internally the form of a funnel, and their shape is nearly that of a mutilated cone or round pyramid. This is the natural and unavoidable consequence of the perpendicular fall of the pulverised matter which the volcano discharges from the orifice at the bottom. The sides of the craters are not all of one height; the parts to the east and west being considerably higher than the intermediate summits, because the currents of the ashes passed alternately from east to west, and fell upon these sides in greater quantities than on the others; which circumstance has given to this volcano the appearance of having two summits.

M. Houel, having finished his observations on Monte Rosso, returned to the convent of Nicolosi, which is now only an house for the entertainment of travellers. The Benedictines of Catana, to whom it belongs, visit this place only when in an ill state of health, as the purity of the air renders it very salutary to the human constitution. A solitary brother, however, resides here to take care of the house, and to superintend the cultivation of the neighbouring plains. Those fathers once possessed an extensive and very fertile tract of land in this neighbourhood; but the eruptions of Etna have rendered it totally incapable of cultivation. This house stands at a very considerable height, being no less than two thousand four hundred and ninety-six feet above the level of the sea. Setting out from this place three hours before day, our traveller directed his course towards the grotto of the goats. In his way thither, he passed over several plains of lava, some of them ancient and others more modern: but the roads were extremely rough and dangerous; or rather, there was no track or path meriting the name of a road. In two hours they reached the Regione Sylvosa, where an immense forest surrounds the mountain, and which has undoubtedly been planted by the hand of nature: for the ground there is so high, so full of precipices, and so entirely uninhabitable, that no human being could ever think of making plantations on it; nor is it to be

supposed, that the winds could take up seeds from the plains to sow them on such a lofty situation.

These majestic forests of Etna afford a singular spectacle, and bear no resemblance of those of other countries. Their verdure is more lively, and the trees of which they consist are of a greater height. These advantages they owe to the soil whereon they grow; for the soil produced by volcanoes is particularly favourable to vegetation, and every species of plants grows here with great luxuriance. In several places where we can view their interior parts, the most enchanting prospects are displayed. The hawthorn-trees are of an immense size. Our author saw several of them of a regular form, and which he was almost tempted to take for large orange-trees cut artificially into the figures they represented. The beeches appear like as many ramified pillars, and the tufted branches of the oak like close bushes impenetrable to the rays of the sun. The appearance of the woods in general is exceedingly picturesque, both by reason of the great number and variety of the trees, and the inequality of the ground, which makes them rise like the seats in an amphitheatre, one row above another; disposing them also in groups and glades, so that their appearance changes to the eye at every step: and this variety is augmented by accidental circumstances, as the situation of young trees among others venerable for their antiquity; the effects of storms, which have often over-turned large trees, while stems shooting up from their roots, like the Lernaean hydra, shew a number of heads newly sprung to make up that which was cut off.

About three hours after the departure of our travellers from St. Nicholas, they reached the grotto of the goats. It is formed by a bed of lava, which, having flowed over a pile of sand and pozzolana while in a fluid state, settled and cooled in that situation; and the sand or pozzolana being afterwards carried off by the filtration of water through the lava, a void space has been left, which the torrents have gradually enlarged to its present size.

This grotto stands about 5054 feet above the level of the sea, according to the calculations of M. de Saussure. It affords a retreat for those travellers who visit the summit of Etna, who generally refresh themselves by taking a repast and making a fire at the entry, for which there is plenty of dry wood at hand; while the sand serves for a bed to repose on. Here our author and his company supped, and about midnight set off for the summit. They had the advantage of the moon-light; and our author advises all those who intend to visit the top of Etna to take such a time for their journey as may enable them to enjoy this advantage. As they advanced beyond the grotto of the goats, the trees became gradually thinner. In a short time they were so thin, that they might readily be counted; and, proceeding still farther, only a very few were seen scattered here and there, whose beauty and size were diminished seemingly in proportion to their numbers. A few clumps of trees and some tufts of odoriferous herbs were now only to be seen; and in a little time these also became thinner, assuming a withered or stunted appearance. Then they are nothing but the languishing remains of an abortive vegetation; and a few paces further not even this appeared, the eye being presented only with barren sand.

Having

Having now got above the region of the trees, they entered the third, which our author denominates the region of snow and sterility. The wind became more brisk and keen as they advanced, so that they could scarcely keep their hats upon their heads. Here they were frequently obliged to cross considerable streams of water formed by the melting of the snow.

Having at last overcome all difficulties, they arrived at the large plain on the summit of Etna, in the midst of which is the crater of the volcano. It is entirely composed of lava, cinders, ice, and snow; nevertheless is styled, ironically as our author thinks, *Monte Friamente*. Here the wind continued to blow with excessive violence; and our author informs us, that in order to have any notion of its keenness, we must be accustomed to feel it on some elevated station, as it is impossible to judge from what we feel at inferior altitudes. They took shelter behind a lump of lava, the only one which appeared in the whole plain, and, which our author says, would seem designed expressly for the shelter of travellers. Here they lay, wrapped up in their cloaks, for an hour; but as soon as it was day, so that they could distinguish the place where the sun was to rise, they got up and advanced towards the ruins of the building known by the name of the Philosopher's Tower. The wind still blew so violently, that after an effort of four minutes they fell down exhausted; but, the extreme cold obliging them again to rise, they made a second attempt; and, after several intermissions of this kind, at last accomplished their design. They were surprised, however, to find nothing but the corner of a wall not more than two feet high, consisting of two rows of unpolished stones; great part of it having been probably buried by the sand and other matters discharged by the mountain. Here, being sheltered from the wind, and the day advancing, they began to enjoy the glorious prospect which every moment became more extensive. At the rising of the sun, the horizon was serene, without a single cloud. The coast of Calabria was as yet undistinguishable from the adjoining sea; but in a short time a fiery radiance began to appear from behind the Italian hills, which bounded the eastern part of the prospect. The fleecy clouds, which generally appear early in the morning, were tinged with purple; the atmosphere became strongly illuminated, and, reflecting the rays of the rising sun, appeared filled with a bright effulgence of flame. The immense elevation of the summit of Etna made it catch the first rays of the sun's light, whose vast splendor, while it dazzled the eyes, furnished a most cherishing and enlivening heat, reviving the spirits, and diffusing a pleasant sensation through the soul. But, though the heavens were thus enlightened, the sea still retained its dark azure, and the fields and forests did not yet reflect the rays of the sun. The gradual rising of this luminary, however, soon diffused his light over the hills which lie below the peak of Etna. This last stood like an island in the midst of the ocean, with luminous points every moment multiplying around, and spreading over a wider extent with the greatest rapidity. It was as if the universe had been observed suddenly springing from the night of non-existence. The tall forests, the lofty hills, and extensive plains, of Etna, now presented themselves to view. Its base, the vast tracts of level ground which lie adjacent, the cities of Sicily, its parched shores, with the dashing waves and vast expanse of the ocean, gradually presented themselves,

while

while some fleeting vapours, which moved swiftly before the wind, sometimes veiled part of this vast and magnificent prospect." In a short time every thing was displayed so distinctly, that they could plainly recognize all those places with which they were before acquainted. On the south were seen the hills of Camerata and Trapani; on the north, the mounts Pelegrino and Thermini, with the celebrated Enna once crowned with the temples of Ceres and Proserpine. Among these mountains were seen a great many rivers running down, and appearing like as many lines of glittering silver winding through a variety of rich and fertile fields, washing the walls of 20 cities, while their banks were otherwise filled with villages, hamlets, &c. rising among the ruins of the most illustrious republics of antiquity. On the south and north were observed the rivers which bound by their course the vast base of mount Etna, and afford a delightful prospect to the eye; while at a much greater distance were seen the isles of Lipari, Alicudi, Felicocide, Parinacia, and Stromboli.

Having enjoyed for some time the beauty of this magnificent prospect, our author set about making a draught of the place from which the view was taken; and at length accomplished it, notwithstanding the great impediments he met with from the wind. Among the objects which he delineated on this occasion, the Philosopher's Tower was one. It seems, he says, not to be very ancient; neither the materials of which it consists, nor the mode of architecture, bearing any resemblance to those of the Greeks and Romans. The surrounding plain seems to consist entirely of a black sand intermixed with pieces of scoria, which have been formerly thrown out by the volcano. Beyond that plain, which rises gently, appears a cone, the summit of which is the volcanic crater. When viewed from the south side, on which they stood, this crater seems to consist of a number of small hills. Into these it was broken by the emission of the boiling torrent in the year 1753. When discharged from the crater, these waters spread towards the right, and at the distance of a mile eastward fell in a cascade from a prodigious height.

The violence of the wind beginning now to abate, the travellers set out for the very summit, in order to take a view of the great crater; in which journey it would be difficult to make people, who have never engaged in such enterprises, comprehend all the obstacles they had to encounter. This cone is composed of ashes, sand, and *poz-zolano*, thrown up at different times by the volcano. The materials are so loose, that the adventurous traveller sinks about mid-leg at every step, and is in constant terror of being swallowed up. At last, when the summit is reached, the sulphureous exhalations, which are continually emitted from the pores of the mountain, threaten suffocation, and irritate the fauces and lungs in such a manner as to produce a very troublesome and incessant cough. The looseness of the soil, which gives way under the feet, obliges the traveller, every now and then, to throw himself flat on his belly, that so he may be in less danger of sinking. In this posture M. Houel viewed the wide unfathomable gulph in the middle of the crater; but could discover nothing except a cloud of smoke, which issued from a number of small apertures scattered all around, and accompanied with a kind of noise. Another and more dreadful sound, however, issues from the bowels of the volcano, which strikes the heart with terror, so that

that all the strength of reason is necessary to prevent the observer from flying with precipitation from such a dreadful place. Several travellers, who had visited this cone before M. Houel, were so terrified by these dreadful sounds, that they fled with the utmost haste till they arrived at the foot of the mountain.

Our author compares these sounds to a discharge of cannon in the wide abyss; the noise of which is rebellowed throughout all the caverns, and produce a sound perhaps the most alarming that can be imagined; and, during the short space in which he listened, several of these discharges were heard to follow one another almost uninterruptedly.

This dreadful noise, our author, with very great probability, supposes to be occasioned by the explosions of the internal fire, or, as he calls it, the *focus* of the volcano; which striking against the sides of these immense caverns, the sounds produced are re-echoed through their cavities, and probably multiplied in an extraordinary manner; so that what would be only a slight explosion in the open air, occasions a sound more tremendous than the loudest thunder. To such as are convinced of this, and have sufficient courage to resist the first impressions which these sounds must unavoidably occasion, they will in a short time not only appear exceedingly sublime, but, by their variety, even somewhat agreeable. They also enable us to form some conception of the space through which they must pass before they reach the ear, and of the vast extent and width of the hollows of the mountain.

Having for some time contemplated this awful spectacle, our author wished to measure the crater by walking round it; but found this impossible. On the north side the surface is hard and smooth, the ashes having been so far dissolved by the moisture deposited by the smoke as to cement into one uniform mass. This is sometimes dissolved even into a fluid state, in such a manner as to run down the sides of the cone; so that, after several attempts, he was at last obliged to abandon his design.

The crater consists of three eminences or divisions; which all together form a triangle nearly equilateral; but, when viewed from any considerable distance, only two of them can be seen; for which reason the Sicilians have termed the mountain *bicornæ*, or double-horned. The smoke issues from all quarters, either from chinks or holes scattered over the whole crater. But the situation of the principal mouth is in the midst of the three eminences. The cone is not exactly in the middle of the plain, but is situated more towards the north than the south. He did not attempt to cross the central valley, on account of the looseness of the ground, and that there was no object apparently worthy of the risk he must run in so doing. At the nearest view he took, it was only observed that there was snow lying in several parts of it, though the heat which otherwise prevailed seemed to be very intense.

The smoke which issues from the crater of Etna is generally carried in a direction from south to north; and, as it brings along with it a considerable quantity of water, the latter, condensed by the cold winds, runs down the side of the mountain in plentiful streams, and often leaves pretty permanent marks of its course. In this manner he accounts for the great eruption of water in 1755, which he supposes to have been occasioned only by an unusual quantity of water falling

falling into the burning focus of the mountain, there rarefied into steam, and afterwards condensed by the coldness of the atmosphere.

Like other travellers to mount Etna, this gentleman found the wind blowing from the south; and he is of opinion that a south wind blows here more frequently than any other, as he did not observe any channels cut by the water on any other side than the north. He had several opportunities of making this observation, having frequently visited the top of Etna, and always paid attention to the crater. The sand on the east and west sides was always loose, while that on the north was compacted into a solid body. The three summits were of a later date than the rest of the crater, having been probably thrown up by some eruption which had burst it asunder. Here are a number of hillocks about the size of mole-hills, from which a sulphureous vapour constantly issues, and by which the adjacent ground is tinged of an ochery colour. This vapour issues from the crevices with a kind of hollow whistling noise; which with the volcanic thunder, smoke, and noxious smell, render it very disagreeable to stay here even for a few moments.

The smoke does not always rise perpendicularly, for, when the cold is very intense, it collects into a body, and thickens around the edge of the crater: on which occasions it is condensed into water, which diffuses itself around the edge of the crater, and mixing with the ashes converts them into a kind of clay. The cold on the top of this mountain is so intense, that travellers very often find their clothes insufficient to protect them; and it is remarkable that such intense cold is always produced by a south wind.

The base of mount Etna, according to M. Houel's observations, consists of alternate layers of lava and marine substances, which have been deposited successively one upon another. These alternate layers extend to an unknown depth. They must indeed go as far down as the level of the stratum of lava which was discharged by the volcano at its first origin. The last deposited by the sea is a range of calcareous mountains of a considerable height, and which are placed on a basis of lava. Beneath that layer of lava is another of sea-pebbles, which are well-known to be rounded by their attrition against one another by the motion of the waves. This layer is of considerable depth, and lies upon a yellowish rock consisting of a species of indurated sand. The river Simeto flows over this rock, which it has cut away considerably. That part which is at present the bed of the river is much higher than the base of Etna that is on a level with the sea; and not the least thing occurs to suggest an idea of what has been the primary base of the volcano. The marine substances, already taken notice of, lie nearly in an horizontal direction, more or less so according to the nature of the surface on which they have been deposited.

Etna abounds very much with springs, fountains, and even rivers of considerable magnitude. Our author has computed, that, if all the water flowing down the sides of this mountain were collected, it would fill the channel of a river thirty-six feet broad and six in depth. Many of the springs afford fine salt; some are very pure, and others are impregnated with noxious substances; while others are remarkable for their use in dyeing particular colours.

It is worthy of notice, says M. Houel, that streams of water, some of them more copious, others more scanty, are seen to issue
at

at all different degrees of height, from the base to the summit of the mountain. Even in summer, when very little rain falls for three or four months, or when perhaps for that space there is not an ounce of snow melted; even then a great number of rivulets continue to flow down the sides of Etna; and at the same time a number of streams, external and subterraneous, each of them several feet wide, are, according to the accounts of the country people, plentifully supplied with water.

"As the trifling quantity of snow which is melted here even in the midst of summer, and the still smaller quantity deposited by the clouds, would be totally insufficient to supply those streams, and must be all absorbed by the earth for the support of vegetation, those streams must proceed from some other cause, whose effects are more copious and permanent. This cause is the evaporation of those aqueous particles which arise from the constant ebullition at the bottom of the volcanic focus. These issuing out at the great crater, and at innumerable chinks in the sides of the mountain, are soon condensed by the cold of that elevated region of the atmosphere, and, percolating through the earth, give birth to those numerous streams in question.

"A volcano, says M. Houel, cannot subsist without water; nor can water occupy a place in any volcanic focus without being changed into vapour. But before that water can make its appearance, except in the form of smoke, it must have filled the whole volcanic cavern, and must have been forcibly pressed by the action of the fire against its sides: it must next have condensed, and assumed the form of water; in which state it must have penetrated through the inclined layers of sand and pozzolano which intervene betwixt the different strata of lava; for these strata lie one above another, and are full of chinks, in such a manner as to present to the eye an appearance pretty much resembling that of the inside of a tiled roof."

It has been a question, Whether the eruptions of mount Etna were more frequent in ancient than in modern times? At first it seems impossible to give a precise answer to such a question; but when we consider, that the matter in the volcanic focus was then greater in quantity than at present, in proportion to the space which it occupied; that the cavities were then sooner filled with vapour; and that the centre of the focus was then less remote; we shall not hesitate to pronounce, that in earlier times the eruptions were more frequent as well as more copious.

We shall close this account with an enumeration of all the different eruptions from mount Etna which are found upon record.

1. The first mentioned in history, is that of which Diodorus Siculus speaks, but without fixing the period at which it happened. That eruption, says he, obliged the Sicani, who then inhabited Sicily, to forsake the eastern, and retire to the southern, part of the island. A long time after that, the Sicilians, a people of Italy, migrated into Sicily, and took up their abode in that part of the island which had been left desert by the Sicani.

2. The second eruption known to have issued from this volcano, is the first of the three mentioned by Thucydides; of none of which he fixes the date, mentioning only in general, that from the arrival of the first Greek colonies that settled in Sicily (which was in the

11th Olympiad, and corresponds to the 734th year before the Christian era) to the 88th Olympiad, or the year 425 before Christ, Etna at three different times discharged torrents of fire. This second eruption happened, according to Eusebius, in the days of Phalaris, in the 565th year before the Christian era.

3. The third, which is the second of the three mentioned by Thucydides, happened in the 65th Olympiad, in the 477th year before the Christian era, when Xantippus was archon at Athens. It was in this same year the Athenians gained their boasted victory over Xerxes's general Mardonius near Platæa. Both the eruption of the volcano and the victory of the Athenians are commemorated in an ancient inscription on a marble table which still remains. An ancient medal exhibits a representation of an astonishing deed to which that eruption gave occasion. Two heroic youths boldly ventured into the midst of the flames to save their parents. Their names, which well deserved to be transmitted to future ages, were Amphinomus and Anapius. The citizens of Catania rewarded so noble a deed with a temple and divine honours. Seneca, Silius Italicus, Valerius Maximus, and other ancient authors, mention the heroism of the youths with just applause.

4. The fourth eruption, the third and last of those mentioned by Thucydides, broke out in the 88th Olympiad, in the 425th year before the Christian era. It laid waste the territory of Catania.

5. The fifth is mentioned by Julius Obsequens and Orosius, who date it in the consulship of Sergius Fulvius Flaccus and Quintus Calpurnius Piso, nearly one hundred and thirty-three years before the Christian era. It was considerable; but no peculiar facts are related concerning it.

6. In the consulship of Lucius Emilius Lepidus and Lucius Aemilius Orestes, in the 125th year before the Christian era, Sicily suffered by a violent earthquake. Such a deluge of fire streamed from Etna as to render the adjoining sea into which it poured absolutely hot. Orosius says, that a prodigious quantity of fishes were destroyed by it. Julius Obsequens relates, that the inhabitants of the isles of Lipari ate such a number of those fishes, as to suffer in consequence of it by a distemper which proved very generally mortal.

7. Four years after the last mentioned, the city of Catania was desolated by another eruption not less violent. Orosius relates, that the roofs of the houses were broken down by the burning ashes which fell upon them. It was so dreadfully ravaged, that the Romans found it necessary to grant the inhabitants an exemption from all taxes for the space of ten years, to enable them to repair it.

8. A short time before the death of Cæsar, in the 43d year before Jesus Christ, there was an eruption from mount Etna. Livy mentions it. It was not distinguished by any thing extraordinary. It was afterwards considered as an omen of the death of Cæsar.

9. Suetonius, in the life of Caligula, mentions an eruption from mount Etna which happened in the 40th year after the Christian era. The emperor fled on the very night on which it happened, from Messina, where he at that time happened to be.

10. Carrera relates, that in the year 253 there was an eruption from mount Etna.

11. He speaks of another in the year 420; which is also mentioned by Photius.

12. In

12. In the reign of Charlemagne, in the year 812, there was an eruption from Etna. Geoffroy of Viterbo mentions it in his Chronicle.

13. In the year 1167, on the 4th of February, about day-break, there was an earthquake in Sicily, which was felt as far as Reggio, on the opposite side of the strait. Catania was reduced by it to ruins; and in that city more than fifteen thousand souls perished. The bishop, with forty-four monks of the order of St. Benedict, were buried under the ruins of the roof of the church of St. Agatha. Many castles in the territories of Catania and Syracuse were overturned; new rivers burst forth, and ancient rivers disappeared. The ridge of the mountain was observed to sink in on the side next Taormina. The spring of Arethusa, so famous for the purity and sweetness of its waters, then became muddy and brackish. The fountain of Ajo, which rises from the village of Saraceni, ceased to flow for two hours; at the end of which the water gushed out more copiously than before. Its waters assumed a blood-colour, and retained it for about an hour. At Messina, the sea, without any considerable agitation, retired a good way within its ordinary limits; but soon after, returning, it rose beyond them, advanced to the walls of the city, and entered the streets through the gates. A number of people who had fled to the shore for safety were swallowed up by the waves. Ludovico Aurelio relates, that the vines, corn, and trees of all sorts, were burnt up, and the fields covered over with such a quantity of stones as rendered them unfit for cultivation.

14. Twelve years after this, in the year 1181, a dreadful eruption issued from Etna on the east side. Streams of fire ran down the declivity of the mountain, and encircled the church of St. Stephen, but without burning it. Nicolas Speciale, who relates, though he did not see, this event, was witness to another conflagration on Etna forty-eight years after this, in the year 1229, on the 23d of June, of which he has given a description.

15. On that day, says he, about the hour of vespers, Etna was strongly convulsed, and uttered dreadful noises; not only the inhabitants of the mountain, but all Sicily, were struck with consternation and alarm. On a sudden, a terrible blaze of fire issued from the southern summit, and spread over the rocks of Mazarra, which are always covered with snow. Together with the fire, there appeared a great deal of smoke. After sun-set, the flames and the stones that issued out with them were seen to touch the clouds. The fire, making way for itself with the most furious impetuosity, burnt up or reduced to ruins all those structures which the piety of former times had consecrated to the Deity. The earth, yawning, swallowed up a great many springs and rivulets. Many of the rocks on the shore of Mascali were shaken and dashed into the sea. A succession of these calamities continued till the 15th of July, when the bowels of Etna were again heard to rebellow. The conflagration of Mazarra still went on unextinguished. The earth opened near the church of St. John, called *Il Paparinacca*; on the south side fire issued from the gap with great violence: to add to the horrors of the day, the sun was obscured from morning to evening with clouds of smoke and ashes, as entirely as in an eclipse. Nicolas Speciale went towards the new-opened crater, to observe the fire and the burning stones which were issuing from the volcano. The earth rebellowed

and tottered under his feet; and he saw red-hot stones issue four times successively in a very short space from the crater, with a thundering noise, the like of which, he says, he had never before heard.

In a few days after this, all the adjacent fields were burnt up by a shower of fire and sulphureous ashes; and both birds and quadrupeds, being thus left destitute of food, died in great numbers. A great quantity of fishes likewise died in the rivers and the contiguous parts of the sea. "I cannot think (says he) that either Babylon or Sodom was destroyed with such awful severity." The north winds, which blew at the time, carried the ashes as far as Malta. Many persons of both sexes died of terror.

16. Scarcely had four years elapsed after this terrible event, when Etna made a new explosion, and discharged volleys of stones, causing the neighbouring fields to tremble. This happened in the year 1333.

17. Forty-eight years after this, on the 25th of August 1381, an eruption from Etna spread its ravages over the confines of the territory of Catania, and burnt up the olive-yards in the neighbourhood of that city.

18. In the year 1444, sixty-three years after the last eruption, a torrent of lava issued from Etna and ran towards Catania. The mountain shook; and the shocks were so violent, that several huge masses of rock were broken from its summit, and hurled into the abysses with a tremendous noise.

19. After this Etna was scarcely at rest for eighteen months or two years. On Sunday the 25th of September 1446, about an hour after sun-set, an eruption issued from the place called *La Pietra di Mazarra*. This eruption was soon over.

20. On the following year, 1447, on the 21st of September, there was another, with a good deal of fire; but this eruption was likewise of short duration.

21. Etna now ceased to emit fire, and that for a considerable time. The neighbouring inhabitants not only ascended to the summit of the mountain, but even, if we may credit accounts, went down into the fiery gulph, and believed the volcanic matter to be now exhausted:—But on the 25th of April 1536, near a century from the slight eruption in 1447, a strong wind arose from the west, and a thick cloud, reddish in the middle, appeared over the summit of the mountain. At the very same instant a large body of fire issued from the abyss, and fell with the noise and rapidity of a torrent along the eastern side of the mountain, breaking down the rocks, and destroying the flocks and every other animal that was exposed to its fury. From the same crater, on the summit of the mountain, there issued at the same time a stream of fire more terrible than the other, and held its course towards the west. It run over Bronte, Adrans, and Castelli. It consisted entirely of sulphur and bitumen. On the same day the church of St. Leon, which stood in a wood, was first demolished by the shocks of the earthquake, and its ruins after that consumed by the fire. Many chasms were opened in the sides of the mountain; and from those issued fire and burning stones, which darted up into the air with a noise like that produced by a smart discharge of artillery. Francis Negro de Piazza, a celebrated physician, who lived at Lentini, wishing to have a nearer view of the eruptions, and to make some observations which he thought might be of consequence,

was

was carried off and burnt to ashes by a volley of the burning stones. This conflagration of Etna lasted some weeks.

22. In less than a year, on the 17th of April 1537, the river Simeto swelled so amazingly as to overflow the adjacent plains, and carry off the country people and their cattle and other animals. At the same time, the country around Paternò, the neighbouring castles, and more than five hundred houses, were destroyed by the ravages of the river; and most of the wood was torn up by the roots by violent blasts of wind. These ravages of the elements were occasioned by Etna, which on the 11th of the following month was rent in several places, disclosing fiery gulphs, and pouring out a deluge of fire in more terrible torrents than those of the preceding year. They directed their course towards the monastery of St. Nicholas d'Arena; destroyed the gardens and vineyards; and proceeding onwards towards Nicolosi, burnt Montpelleri and Fallica, and destroyed the vineyards and most of the inhabitants. When the conflagration ceased, the summit of the mountain sunk inward with such a noise, that all the people in the island believed the last day to be arrived, and prepared for their end by extreme unction. These dreadful disturbances continued through the whole year, more especially in the months of July and August, during which all Sicily was in mourning. The smoke, the noise, and the shocks of the earthquake, affected the whole island; and if Filotes may be believed, who relates this event, many of the Sicilians were struck deaf by the noise. Many structures were demolished; and among others the castle of Corleone, though more than twenty-five leagues distant from the volcano.

23. During the succeeding thirty years there was no disturbance of this nature. At the end of that space, Sicily was alarmed by a new eruption from the mountain. Etna discharged new streams of fire, and covered the adjacent country with volcanic ashes, which entirely ruined the hopes of the husbandman.

24. In the year 1579, Etna renewed its ravages; but no particular account of the damage which it did upon this occasion has been recorded.

25. Twenty-five years had elapsed, when Etna, in the month of June 1603, flamed with new fury. Peter Carrera affirms, that it continued to emit flames for the space of thirty-three years, till 1636, without interruption, but not always with the same violence. In 1607, the streams of lava which flowed from it destroyed the woods and vineyards on the west side of the mountain. In 1609, they turned their course towards Aderno, and destroyed a part of the forest del Pino, and a part of the wood called *la Sciambrita*, with many vineyards in the district Costerna. Those torrents of lava continued to flow for three months. In the year 1614, a new effort of the subterraneous fire opened another crater, from which fire was discharged on Randazzo, in the district called *il Piro*. The fire continued to flame for ten or twelve years longer.

26. The same Peter Carrera relates, that a dreadful conflagration happened in the year 1664, of which he himself was witness. It happened on the 13th of December, and lasted without interruption, but with different degrees of violence, till the end of May 1678. But in 1669 the inhabitants of Nicolosi were obliged to forsake their houses, which tumbled down soon after they left them. The crater

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on the summit of Etna had not at this time a threatening aspect, and every thing there continued quiet till the 25th of March: but on the 8th of that month, an hour before night, the air was observed to become dark over the village la Pedara and all that neighbourhood; and the inhabitants of that country thought that an almost total eclipse was taking place. Soon after sun-set, frequent shocks of earthquake began to be felt; these were at first weak, but continued till day-break to become more and more terrible. Nicolosi was more affected than any other tract of country on that side of Etna: about noon every house was thrown to the ground; the inhabitants fled in consternation, and invoking the protection of heaven. On the 10th of March a chasm several miles in length, and five or six feet wide, opened in the side of the mountain; from which, about two hours before day, there arose a bright light, and a very strong sulphureous exhalation was diffused through the atmosphere. About eleven in the forenoon of the same day, after dreadful shocks of earthquake, a crater was opened on the hill called *des Noisettes*, from which there issued huge volumes of smoke, not accompanied with fire, ashes, or stones, but with loud and frequent claps of thunder, displaying all the different phenomena with which thunder is at different times attended. And what was very remarkable, the chasm was formed on the south side, between the top and the bottom of the mountain. On the same day another chasm was formed two miles lower, from which issued a great deal of smoke, accompanied with a dreadful noise and earthquake. Towards the evening of the same day, four other chasms were opened towards the south, in the same direction, accompanied during their formation with the same phenomena, and extending all the way to the hill called *la Fufara*. About twelve paces beyond that, another of the same kind was formed. On the succeeding night, a black smoke, involving a quantity of stones, issued from this last chasm; it discharged at the same time flakes of a dark earth-coloured spongy matter, which became hard after they fell. There issued from the same gulph a stream of lava, which held its course into a lake called *la Hardia*, six miles from Montpellieri, and on its way thither destroyed many dwelling-houses and other buildings in the neighbouring villages.

On the next day, March 12th, this stream of fire directed its course towards the tract of country called *Malpasso*, which was inhabited by eight hundred people: in the space of twenty hours it was entirely depopulated and laid waste. The lava then took a new direction, in which it destroyed some other villages. The mount of Montpellieri was next destroyed with all the inhabitants upon it.

On the 23d of the same month the stream of fire was in some places two miles broad. It now attacked the large village of Mazzalucia; and on the same day a vast gulph was formed, from which were discharged sand or ashes, which produced a hill with two summits, two miles in circumference and one hundred and fifty paces high. It was observed to consist of yellow, white, black, grey, red, and green, stones. The new mount of Nicolosi continued to emit ashes for the space of three months; and the quantity discharged was so great as to cover all the adjoining tract of country for the space of fifteen miles: some of those ashes were conveyed by the winds as far as Messina and Calabria; and a north wind arising, covered all the southern country about Agosta, Lentini, and even

even beyond that, in the same manner. While at that height on Nicolosi so many extraordinary appearances were passing, the highest crater on the summit of Etna still preserved its usual tranquillity.

On the 25th of March, about one in the morning, the whole mountain, even to the most elevated peak, was agitated by a most violent earthquake. The highest crater of Etna, which was one of the loftiest parts of the mountain, then sunk into the volcanic focus; and in the place which it had occupied, there now appeared nothing but a wide gulph more than a mile in extent, from which there issued enormous masses of smoke, ashes, and stones. At that period, according to the historian of this event, the famous block of lava on mount Frumento was discharged from the volcanic focus.

In a short time after, the torrent of fire, which still continued to flow, directed its course towards Catania with redoubled noise, and accompanied with a much greater quantity of ashes and burning stones than before. For several months many most alarming shocks of earthquake were felt; and the city was threatened with destruction by the torrent of fire. They in vain attempted to turn or divert its course; the lava rose over the walls, and entered by an angle near the Benedictine convent on the 11th of June following. This awful event is related by Francis Monaco, Charles Mancius, Vincent Auria, and Thomas Thedeschi.

27. Some years after this conflagration, a new burning gulph opened in the month of December 1682 on the summit of the mountain, and spread its lava over the hill of Mazarra.

28. On the 24th of May 1686, about ten in the evening, a new eruption burst out from the summit of the mountain, on the side contiguous to the hill del Bue. Such a quantity of inflamed matter was thrown out as consumed woods, vineyards, and crops of grain, for four leagues round. It stopped its course in a large valley near the castle of Mascali. Several people from the neighbourhood had ascended a hill between the wood of Catania and the confines of Cirrita to observe the progress of the lava: but the hill, on a sudden, sunk inwards, and they were buried alive.

29. Etna was now long quiet; for no less a space of time indeed than one half of the present age. In the year 1755 its eruptions were renewed. It opened near mount Lepira, and emitted as usual fire and smoke; after which it remained quiet only for eight years.

30. In the year 1763, there was an eruption which continued three months, but with intervals. Etna was at first heard to rebellow. Flames and clouds of smoke were seen to issue out, sometimes silver-coloured, and at other times, when the rays of the sun fell upon them, of a purple radiance: at length they were carried off by the winds, and rained, as they were driven before them, a shower of fire all the way to Catania and beyond it. An eruption soon burst out; the principal torrent divided into two branches, one of which ran towards the east, and fell into a deep and extensive valley. The flames which issued from this new crater afforded an awful spectacle. A pyramid of fire was seen to rise to a prodigious height in the air, like a beautiful artificial fire-work, with a constant and formidable battery, which shook the earth under those who were spectators of the scene. Torrents of melted matter, running down the sides of the mountain, diffused a light bright as day through the darkness of night.

At sun-rising the burning lava was observed to have run round some oaks that were still standing unburnt. Their leaves were all withered. Some birds had fallen from their branches, and been burnt to death. Some people cast wood upon the lava, and it was immediately burnt. This lava continued hot, and exhaled smoke, for two years. For five years after this, no snow appeared on the summit of Etna.

31. In the year 1764 a new crater was opened at a great distance from mount Etna.

32. In the year 1766 another was opened at the grotto of Paterno: fire, smoke, and an inconsiderable torrent of lava, issued out of it.

33. On the 27th of January 1780 a new opening was formed two miles under the last mentioned crater. On the 28th of February, and the 14th of March, the earthquake was renewed on the north side, and accompanied with terrible noises.

Between the 6th of April and the 7th of May the convulsions were renewed, accompanied with noise as before; a quantity of pumice-stones and fine sand was discharged from it.

On the 18th of May the shocks were renewed: on the 23d a new crater was formed on the side of Mount Frumento on the summit of Etna; and from it a torrent of lava discharged, which spread through the valley of Laudunza. It was 200 paces in breadth. Two other chinks were opened in the mountain near Paterno, and very near one another. The lava issuing from them proceeded in the space of seven days six miles; on the 25th it had run nine miles.

A new crater was likewise opened on the 25th; from which a quantity of red-hot stones continued to issue for half an hour, and fell at a very great distance: there proceeded likewise from it a stream of lava; which, in the space of time, ran over a tract of country two miles in extent.

Several parts of those streams of lava were observed to be cool on the surface, and formed into solid masses, but melted again by a new stream of burning lava, which however did not melt the old lava.

34. The last eruption of Etna happened in 1787. From the 1st to the 10th of July, there were signs of its approach. On the 11th, after a little calm there was a subterraneous noise, like the sound of a drum in a close place, and it was followed by a copious burst of black smoke. It was then calm till the 15th, when the same prognostics recurred. On the 17th, the subterraneous noise was heard again; the smoke was more abundant, slight shocks of an earthquake followed, and the lava flowed from behind one of the two little mountains which form the double head of Etna. On the 18th, while the spectators were in anxious expectation of a more severe eruption, all was quiet, and continued so more than 12 hours: soon after they perceived some new shocks, accompanied with much noise; and the mountain threw out a thick smoke, which, as the wind was westerly, soon darkened the eastern horizon: two hours afterwards a shower of fine black brilliant sand descended: on the east side it was a storm of stones; and, at the foot of the mountain, a deluge of flashes of fire, of scoria, and lava.

These appearances continued the whole day; at the setting of the sun the scene changed. A number of conical flames rose from the volcano; one on the north, another on the south, were very conspicuous, and rose and fell alternately. At three in the morning,
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the mountain appeared cleft, and the summit seemed a burning mass. The cones of light which arose from the crater were of an immense extent, particularly the two just mentioned. The two heads appeared to be cut away: and at their separation was a cone of flame, seemingly composed of many smaller cones. The flame seemed of the height of the mountain, so that it was probably two miles high, on a base of a mile and an half in diameter. This cone was still covered with a very thick smoke, in which appeared very brilliant flashes of lightning, a phenomenon which Etna had not before afforded. At times, sounds like those from the explosion of a large cannon were heard, seemingly at a less distance than the mountain. From the cone, as from a fountain, a jet of many flaming volcanic matters were thrown, which were carried to the distance of six or seven miles: from the base of the cone a thick smoke arose, which, for a moment, obscured some parts of the flame, at the time when the rivers of lava broke out. This beautiful appearance continued three quarters of an hour. It began the next night with more force; but continued only half an hour. In the intervals, however, Etna continued to throw out flames, smoke, stones ignited, and showers of sand. From the 20th to the 22d, the appearances gradually ceased. The stream of lava was carried towards Bronte and the plain of Lago.

After the eruption, the top of the mountain on the western side was found covered with hardened lava, scoria, and stones. The travellers were annoyed by smoke, by showers of sand, mephitic vapours, and excessive heat. They saw that the lava which came from the western point divided into two branches, one of which was directed towards Libeccio; the other, as we have already said, towards the plain of Lago. The lava on the western head of the mountain had from its various shapes been evidently in a state of fusion: from one of the spiracula, the odour was strongly that of liver of sulphur. The thermometer, in descending, was at 40 degrees of Fahrenheit's scale; while near the lava, in the plain of Lago, it was 140 degrees. The lava extended two miles; its width was from 13½ to 21 feet, and its depth 13½ feet.

DESCRIPTION OF THE LIPARI ISLANDS.

LIPARA, the principal of the islands called *Æolia*, situated between Sicily and Italy, with a cognomial town, was formerly so powerful as to have a fleet, and the other islands in subjection to it. According to Diodorus Siculus, it was famous for excellent harbours and medicinal waters. He informs us also, that it suddenly emerged from the sea about the time of Hannibal's death. The name is Punic according to Bochart: and given it, because, being a volcano, it shone in the night. It is now called Lipari, and gives name to nine others in its neighbourhood; viz. Stromboli, Pare, Rotto, Panaria, Saline, Volcano, Felicusa, Alicor, and Ustica. These are called in general the Lipari Islands; and, according to M. Houel, are principally ten in number, the rest being only uninhabitable rocks of narrow extent. The largest and the most populous of them, Lipari, communicates its name to the rest. Volcano is a desert but habitable island, lying south from the large island of Lipari. Salines, which lies west-north-west from the same island; Felicudi, nearly

in the same direction, but twenty miles farther distant; and Alicudi, ten miles south-west of Felicudi; are inhabited. Panaria is east of Lipari, the famous Stromboli north-east, and both of them are inhabited. The rest are in a desert state; such as Basiluzzo, which was formerly inhabited; Attalo, which might be inhabited; and L'Exambianca, on which some remains of ancient dwellings are still to be found. L'Escanera is nothing but a bare rock. The *Fermicoli*, a word signifying ants, are a chain of small black cliffs which run to the north-east of Lipari, till within a little way of Exambianca and Escanera, rising more or less above the water, according as the sea is more or less agitated.

Ancient authors are not agreed with respect to the number of the Lipari islands. Few of those by whom they are mentioned appear to have seen them: and in places such as these, where subterraneous fires burst open the earth and raise the ocean from its bed, terrible changes must sometimes take place. Volcanella and Volcano were once separated by a strait so as to form two islands. The lava and ashes have filled up the intervening strait; and they are now united into one island, and have by this change become much more habitable.

The ancient castle of Lipari stands on a rock on the east quarter of the island. The way to it from the city leads up a gentle declivity. There are several roads to it. This castle made a part of the city; and on the summit of the rock is the citadel, in which the governor and the garrison reside. Here the ancients, in conformity to their usual practice, had built the temple of a tutelary god. This citadel commands the whole city; and it is accessible only at one place. Were an hostile force to make a descent on the island, the inhabitants might retreat hither, and be secure against all but the attacks of famine.

The ancient inhabitants had also fortified this place. Considerable portions of the ancient walls are still standing in different places, particularly towards the south: their structure is Grecian; and the stones are exceedingly large, and very well cut. The layers are three feet high, which shows them to have been raised in some very remote period. These remains are surrounded with modern buildings. The remains of walls, which are still to be seen here, have belonged not only to temples, but to all the different sorts of buildings which the ancients used to erect. The vaults, which are in a better state of preservation than any other parts of these monuments, are converted to the purposes of a prison.

In the city of Lipari there are convents of monks of two different orders; but there are no convents for women, that is to say, no cloisters in which women are confined; those, however, whose heads and hearts move them to embrace a state of pious celibacy, are at liberty to engage in a monastic life, with the concurrence of their confessors. They put on the sacred habit, and vow perpetual virginity, but continue to live with their father and mother, and mix in society like other women. The vow and habit even enlarge their liberty. This custom, will, no doubt, M. Houel observes, appear very strange to a Frenchwoman; but this was the way in which the virgins of the primitive church lived. The idea of shutting them up together did not occur till the fifth century. The life of these religious ladies is less gloomy than that which those under the same vows lead in other countries. They wear clothes of particular colours, according

as they belong to this or that order. Their dress gives them a right to frequent the churches at any hours; and the voice of censure, which takes particular pleasure in directing her attacks against pious ladies, goes so far as to assert, that some young women assume the habit with no other views but that they may enjoy greater freedom.

In this island oxen of a remarkably beautiful species are employed in ploughing the ground. The ancient plough is still in use here. The mode of agriculture practised here is very expeditious. One man traces a furrow, and another follows to sow in it grain and pulse. The ploughman, in cutting the next furrow, covers up that in which the seed has been sown: and thus the field is both ploughed and sown at once. Nature seems to be here uncommonly vigorous and fertile. Vegetation is more luxuriant, and animals gayer and more healthful, than almost any where else.

Near the city of Lipari, the traveller enters deep narrow roads, of a very singular appearance. The whole island is nothing but an assemblage of mountains, all of them consisting of ashes or lava discharged from the depths of the volcano by which it was at first produced. The particles of this pozzolana, or ashes, are not very hard; the action of the rain-water has accordingly cut out trenches among the mountains; and these trenches, being perhaps less uneven than the rest of the surface, have of consequence been used as roads by the inhabitants, and have been rendered much deeper by being worn for so many ages by the feet of men and other animals. These roads are more than five or six fathoms deep, and not more than seven or eight feet wide. They are very crooked, and have echoes in several places. You would think that you were walking through narrow streets without doors or windows. Their depth and windings shelter the traveller from the sun while he is passing through them; and he finds them deliciously cool.

The first volcanic eruption in the Lipari islands, mentioned in history, is that of which Callias takes notice in his wars of Sicily. Callias was contemporary with Agathocles. That eruption continued without interval for several days and nights; and threw out great stones, which fell at more than a mile's distance. The sea boiled all around the island. The works of Callias are lost, and we know not whether he descended to a detail of particulars concerning the ravages produced by this eruption. Under the consulship of Æmilius Lepidus and L. Aurelius Orestes, 126 years before the Christian era, these islands were affected with a dreadful earthquake. The burning of Etna was the first cause of that. Around Lipari and the adjacent islands, the air was all on fire. Vegetation was withered; animals died; and fusible bodies, such as wax and resin, became liquid. If the inhabitants of Lipari, from whom our author received these facts, and the writers who have handed down an account of them, have not exaggerated the truth, we must believe that the sea then boiled around the island; the earth became so hot as to burn the cables by which vessels were fixed to the shore, and consumed the planks, the oars, and even the small boats.

Pliny, the naturalist, speaks of another similar event which happened thirty or forty years afterwards, in the time of the war of the allied states of Italy against Rome. One of the Æolian islands, says he, was all on fire as well as the sea; and that prodigy continued to appear, till the senate appeased, by a deputation, the wrath of the

gods. From the time of that war, which happened eighty-six years before the birth of our Saviour, till the year 144 of our era, we have no account of any eruption of these volcanoes: and from that period again, till the year 1444, we hear of no explosion from them, that is, for the space of 1300 years. But, at that time, both Sicily and the Æolian islands were agitated by dreadful shocks of earthquake: the volcano of these isles poured forth streams of lava with an awful violence, and emitted a volume of flame and smoke which rose to an amazing height. After that it discharged enormous stones, which fell at the distance of more than six miles.

A century later, in the year 1550, the fury of this volcano was again renewed. The ashes and stones discharged from the crater filled up the strait between Volcano and Volcanello. About two centuries after that, in the year 1739, there was a sixth eruption. The burstings of the volcanic fire were attended with a noise so dreadful, that it was heard as far as Melazzo in Sicily.

Father Leandro Alberti says, that on one of these dreadful occasions, the women of Lipari, after employing in vain all the saints, vowed to drink no more wine if the volcano should spare them. Their giving up this small gratification was doubtless of great service; and yet the eruptions still continue, and have even become more frequent since that time. Only thirty-six years intervened between that eruption and that which happened in the year 1775. The whole island was then shaken; subterraneous thunder was heard; and considerable streams of flame, with smoke, stones, and vitreous lava, issued from the crater. Lipari was covered over with ashes; and part of these was conveyed by the wind all the way into Sicily. Five years after, however, in the month of April 1780, there issued a new explosion from Volcano; the smoke was thick, the shocks constant, and the subterraneous noise very frequent. So great was the consternation among the inhabitants of Lipari on this occasion, that the commander Deodati Dolomieu, who visited these islands not long after that event, informs us, that the inhabitants in general, but especially the women, devoted themselves as slaves to the service of the blessed virgin; and wore on their arms, as tokens of their servitude, small iron chains, which they still continue to wear.

This act of piety, however, was not so efficacious as the deputation of the senate had been. For after that deputation, more than 200 years passed before the Æolian islands were afflicted by any other eruption, at least by any considerable one: whereas, in three years after the ladies devoted themselves in so submissive a manner to the service of the virgin, the isles of Lipari were agitated anew by that fatal earthquake which ravaged Calabria, and part of Sicily, on the 5th of February 1783.

The dry baths of St. Calogero, in the island of Lipari, are stoves, where sulphureous exhalations, known to be of a salutary nature, ascend out of the earth by holes or spiracles. A range of apartments are built around the place where the exhalations arise. The heat is communicated through those apartments in such a way, that when, entering at one end, you advance towards the other, the heat still increases upon you till you gain the middle apartment, and again diminishes in the same manner as you proceed from the middle to the other end of the range of chambers. In consequence of this disposition of these apartments, the sick person can make choice of that temperature

temperature which best suits the nature of his disease. There are a few miserable huts and a small chapel for the accommodation of the people who repair to these baths. The people of the place are ready to attend them. Physicians likewise follow their patients thither, when the disease is of such a nature as to render their attendance requisite, and the patient rich enough to afford them handsome fees: but there is no physician settled in the place. Besides these dry baths, there are baths of hot water distinguished by the name of St. Calogero's baths. There are around them buildings sufficient to lodge a considerable number of sick people with their necessary attendants. At present, however, those buildings are but in a bad condition.

The baths consist of two halls; one square, the other round. The former is antique; it has been built by the Romans; it is arched with a cupola, and twelve feet in diameter; it has been repaired:—The other is likewise arched with a cupola both within and without. The water comes very hot into the first. It gushes up from among pieces of lava, which compose a part of the mountain at the foot of which these baths are built. Those stones remain in their natural state. All that has been done is the raising of a square building inclosing them. Within that building the sick persons either sit down on the stones, or immerse themselves in the intervening cavities which are filled with water. They continue there for a certain time, and approach nearer to, or remain at a farther distance from, the spring, according as their physician directs. The place serves also as a stove. The hot vapours arising from the water communicate to the surrounding atmosphere a considerable degree of heat. It is indeed not inferior to that of the hot baths of Termini, which owe their heat to a similar cause. In these baths, therefore, a person can have the benefit either of bathing in the hot water, or of exposing himself to the vapour, the heat of which is more moderate. The bath before-mentioned, under the appellation of dry bath, is also a stove; but the hot vapour with which it is filled issues directly from the volcano. The place of the bath is, however, at such a distance from the volcanic focus, that the heat is not at all intolerable.

The mountain at the foot of which these baths are situated is round, and terminates at the summit in a rock of petrified ashes, which are very hard and of a very fine grain. This petrification consists of pretty regular strata, and appears to have been greatly prior in its origin to the adjacent rocks; which consist likewise of ashes, but ashes that have been deposited at a much later period. From this rock there proceeds likewise a stream of hot water, by which some mills in the neighbourhood are moved.

It cannot but appear surprising, that nature has placed nearly on the summit of a volcanic mountain springs which supply so considerable a quantity of water. To account for such a phenomenon would be well worthy of some ingenious naturalist. Nor are these hot springs all; proceeding around the same hill, at about a mile's distance, we find a spring of cold water, which originates from the summit of the same rock; that on the north-west produces three hot springs. The cold water is very pleasant to drink, and much used both by men and cattle.

Among these mountains there are many enormous loose masses of lava, the appearance of which M. Houel informs us naturally leads the observer to take notice, that the lava of the volcano of Lipari

Lipari is of a much greater diversity of colours, and those richer and more lively, than the lava of Vesuvius and Etna. The lava of Lipari is in some places, for several miles, of a beautiful red colour. It contains likewise in great abundance small black crystallised scoriæ, as well as the small white grains which are commonly found in lava.

Among the eminences which overlook the city of Lipari, there are some rocks of a species which is very rare in Europe. Those are large masses of vitrified matter, which rise six or eight feet above the surface of the ground, and appear to extend to a great depth under it. They exist, through that range of mountains, in enormous masses, mixed with lavas of every different colour, and always standing detached and insulated. Were they cut and followed under ground, they would probably be found to exist in immense quarries in the bowels of the earth. The glass of which they consist might be employed with great advantage in manufactures. It is ready made, and might be easily purified. It is green, compact, and transparent.

The cultivation of the ground is the chief employment of the inhabitants of Lipari. The possession of a few acres of land here gives a man great importance. Parents, when they settle their children, rather give them money than any part of their lands. More than two-thirds of the island is planted with vines: three-fourths of the grapes which these produce are dried, and sent mostly to London under the name of *passola*. There are different sorts of *passola*: one of these, called the black *passolina*, is prepared from a particular kind of grape, of which the berries are uncommonly small; and sold to Marseilles, Holland, and Trieste. The vines are in small arbours, which rise only to the height of two feet and an half above the ground. Under those arbours there grow beans, gourds, and other leguminous vegetables. In so hot a climate, the shade of the vines does not injure but protect the vegetables growing under it: they would otherwise be withered by the heat of the sun.

The method of preparing *passola* and *passolina* is curious enough:—They first make a *lixivium* of common ashes; after boiling this, they pass it through a cloth or a sieve; they then put it again on the fire; and, when it is observed to boil hard, suddenly immerse the grapes, but instantly bring them out again, and expose them to the sun to dry on broad frames of cane. When sufficiently dry, the raisins are put into casks and barrels to be sold and exported. The number of casks of different sorts of raisins annually exported from Lipari are estimated at ten thousand. This island likewise produces figs. There is some white malmsey and a little red wine exported from it.

About eighty years since, sulphur was one of the articles with which the inhabitants of this island supplied foreign merchants. But that trade has been given up; from an idea which the Liparese entertain, that sulphur infects the air so as to injure the fertility of the vines. The same prejudice prevails in Sicily; but it seems to be ill-founded.

There are courts of justice in Lipari, of the same powers and characters with those in the cities of Sicily. Causes of more than ordinary importance are carried to Palermo. The island is entirely free from every kind of imposition. The king receives nothing from

from it; because Count Roger anciently bestowed on its bishop all his rights of royalty over Lipari. The bishop there received annually from the inhabitants a tenth part of the products of their lands. They afterwards, to prevent fraud, estimated the value of that tithe for one year; and on the condition of their paying in future a sum of money equal to what that year's tithe was valued at, he not only gave up his right to the tithe, but also ceded to them a considerable extent of land which belonged to him.

ACCOUNT OF THE TERMITES, OR WHITE ANTS, WHICH
ARE FOUND IN AFRICA AND OTHER HOT CLIMATES.

THE termites are represented by Linnæus as the greatest plagues of both Indies, and are every way between the tropics so deemed, from the vast damages they cause, and the losses which are experienced in consequence of their eating and perforating wooden buildings, utensils, and furniture, with all kinds of household stuff and merchandize, which are totally destroyed by them, if not timely prevented; for nothing less hard than metal or stone can escape their most destructive jaws.

These insects have generally obtained the name of ants, it may be presumed, from the similarity in their manner of living, which is, in large communities that erect very extraordinary nests, for the most part on the surface of the ground, from whence their excursions are made through subterraneous passages, or covered galleries, which they build whenever necessity obliges, or plunder induces, them to march above ground, and at a great distance from their habitations carry on a business of depredation and destruction, scarcely credible but to those who have seen it. But notwithstanding they live in communities, and are like the ants omnivorous; though like them at a certain period they are furnished with four wings, and emigrate or colonize at the same season; they are by no means the same kind of insects, nor does their form correspond with that of ants in any one state of their existence, which, like most other insects, is changed several times.

It is a little surprising that an accurate natural history of these wonderful insects has not been attempted long since; especially as according to Bosman (who wrote the beginning of this century), in his description of the coast of Guinea, some curious circumstances relative to them must have been known. According to that gentleman, the king was supposed to be as large as a cray-fish. This, though a bad comparison, is pretty near the truth in respect to the size of the female, who is the common mother of the community.

These communities consist of one male and one female, (who are generally the common parents of the whole, or greater part of the rest,) and of three orders of insects, apparently of very different species, but really the same.

Of every species there are three orders; first, the working insects, which for brevity, I shall generally call labourers; next the fighting ones, or soldiers, which do no kind of labour; and, last of all, the winged ones, or perfect insects, which are male and female, and capable of propagation.

The termites bellicosus, being the largest species, is most remarkable, and best known on the coast of Africa, and to this we shall principally confine

confine our description at present. It erects immense buildings of well-tempered clay on earth, which are contrived and finished with such art and ingenuity, that we are at a loss to say, whether they are most to be admired on that account, or for their enormous magnitude and solidity.

The nests of this species are so numerous all over the island of *Bananas*, and the adjacent continent of *Africa*, that it is scarcely possible to stand upon any open place, such as a rice plantation, or other clear spot, where one of these buildings is not to be seen within fifty paces, and frequently two or three are to be seen almost close to each other.

These buildings are usually termed hills, by natives as well as strangers, from their outward appearance, which is that of little hills more or less conical, generally pretty much in the form of sugar-loaves, and about ten or twelve feet in perpendicular height above the common surface of the ground. These hills continue quite bare until they are six or eight feet high; but in time the dead barren clay, of which they are composed, becomes fertilized by the genial power of the elements in those prolific climates, and the addition of vegetable salts, and other matters brought by the wind; and in the second or third year, the hillock, if not over-shaded by trees, becomes, like the rest of the earth, almost covered with grass and other plants; and in the dry season, when the herbage is burnt up by the rays of the sun, it is not much unlike a very large haystack. Every one of these buildings consists of two distinct parts, the exterior and the interior. The exterior is one large shell in the manner of a dome, large and strong enough to inclose and shelter the interior from the vicissitudes of the weather, and the inhabitants from the attacks of natural or accidental enemies. It is always, therefore, much stronger than the interior building, which is the habitable part, divided with a wonderful kind of regularity and contrivance into an amazing number of apartments for the residence of the king and queen, and the nursing of their numerous progeny; or for magazines, which are always found well filled with stores and provisions.

The outward shell or dome is not only of use to protect and support the interior buildings from external violence and the heavy rains; but to collect and preserve a regular degree of genial warmth and moisture, which seems very necessary for hatching the eggs and cherishing the young ones.

The royal chamber, which I call so on account of its being adapted for, and occupied by, the king and queen, appears to be in the opinion of this little people of the most consequence, being always situated as near the center of the interior building as possible, and generally about the height of the common surface of the ground, at a pace or two from the hillock. It is always nearly in the shape of half an egg, or an obtuse oval, within, and may be supposed to represent a long oven. In the infant state of the colony, it is not above an inch or thereabouts in length; but in time will be increased to six or eight inches or more in the clear, being always in proportion to the size of the queen, who, increasing in bulk as in age, at length requires a chamber of such dimensions.

The royal chamber, if in a large hillock, is surrounded by an innumerable quantity of others of different sizes, shapes, and dimensions; but all of them arched in one way or another, sometimes circular,

cular, and sometimes elliptical or oval. These apartments are joined by the magazines and nurseries. The former are chambers of clay, and are always well filled with provisions, which, to the naked eye, seem to consist of the raspings of wood and plants which the termites destroy, but are found in the microscope to be principally the gums or inspissated juices of plants. These are thrown together in little masses, some of which are finer than others, and resemble the sugar about preserved fruits; others are like tears of gum, one quite transparent, another like amber, a third brown, and a fourth quite opaque, as we see often in parcels of ordinary gums.

All these chambers, and the passages leading to and from them, being arched, they help to support one another; and while the interior large arches prevent them falling into the center, and keep the area open, the exterior building supports them on the outside.

The interior building or assemblage of nurseries, chambers, &c. has a flattish top or roof without any perforation, which would keep the apartments below dry, in case through accident the dome should receive any injury and let in water; and it is never exactly flat and uniform, because they are always adding to it by building more chambers and nurseries: so that the divisions or columns between the future arched apartments resemble the pinnacles upon the fronts of some old buildings, and demand particular notice, as affording one proof that for the most part these insects project their arches, and do not make them by excavation.

The area has also a flattish floor, with lies over the royal chamber, but sometimes a good height above it, having nurseries and magazines between. It is likewise water-proof, and contrived, to let the water off if it should get in, and run over by some short way into the subterraneous passages which run under the lowest apartments in the hill in various directions, and are of an astonishing size, being wider than the bore of a great cannon.

These subterraneous passages or galleries are lined very thick with the same kind of clay of which the hill is composed, and ascend the inside of the outward shell in a spiral manner, and winding round the whole building up to the top intersect each other at different heights, opening either immediately into the dome in various places, and into the interior building, the new turrets, &c. or communicating thereto by other galleries of different bores or diameters, either circular or oval.

The next kind of nests built by another species of this genus, the *termes arborum*, have little resemblance to the former in shape or substance. These are generally spherical or oval, and built in trees. Sometimes they are seated between the arms and the stems of trees, and very frequently may be seen surrounding the branch of a tree at the height of seventy or eighty feet; and (though but rarely of so large a size) as big as a very great sugar-cask.

They are composed of small particles of wood, and the various gums and juices of trees, combined with perhaps those of the animals, and worked by those little industrious creatures into a paste, and so moulded into innumerable little cells of very different and irregular forms, which afford no amusing variety, and nothing curious but the immense quantity of inhabitants, young and old, with which they are at all times crowded; on which account they are sought for in order to feed young fowls, and especially for the rearing of tur-

kies. These nests are very compact, and so strongly attached to the boughs on which they are fixed, that there is no detaching them but by cutting them in pieces, or sawing off the branch; and they will sustain the force of a tornado as long as the tree on which they are fixed. This species has the external habit, size, and almost the colour, of the *termes atrox*.

There are of every species of termites three orders; of these orders the working insects, or labourers, are always the most numerous: in the *termes bellicosus* there seems to be at least one hundred labourers to one of the fighting insects or soldiers. They are in this state about one-fourth of an inch long, and twenty-five of them weigh about a grain; so that they are not so large as some of our ants. From their external habit and fondness for wood, they have been expressly called Wood Lice by some people, and the whole genus has been known by that name, particularly among the French. They resemble them, it is true, very much at a distance; but they run as fast or faster than any other insects of their size, and are incessantly bustling about their affairs.

The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former neuters; but they are, in fact, the same insects as the foregoing, only they have undergone a change of form, and approached one degree nearer to the perfect state. They are now much larger, being half an inch long, and equal in bulk to fifteen of the labourers.

The third order, or the insect in its perfect state, varies its form still more than ever. The head, thorax, and abdomen, differ almost entirely from the same parts in the labourers and soldiers; and besides this, the animal is now furnished with four fine large brownish transparent wings, with which it is, at the time of emigration, to wing its way in search of a new settlement. In short, it differs so much from its form and appearance in the other two states, that it has never been supposed to be the same animal but by those who have seen it in the same nest; and some of these have distrusted the evidence of their senses.

In the winged state they have also much altered their size as well as form. Their bodies now measure between six and seven tenths of an inch in length, and their wings above two inches and a half from tip to tip, and they are equal in bulk to about thirty labourers, or two soldiers. They are now also furnished with two large eyes placed on each side of the head, and very conspicuous; if they have any before, they are not easily to be distinguished. Probably in the two first states, their eyes, if they have any, may be small like those of moles; for, as they live like these animals always under ground, they have as little occasion for these organs, and it is not to be wondered at that we do not discover them; but the case is much altered when they arrive at the winged state, in which they are to roam, though but for a few hours, through the wide air, and explore new and distant regions. In this form the animal comes abroad during or soon after the first tornado, which at the latter end of the dry season proclaims the approach of the ensuing rains, and seldom waits for a second or third shower, if the first, as is generally the case, happens in the night, and brings much wet after it.

The

The quantities that are to be found the next morning all over the surface of the earth, but particularly on the waters, is astonishing; for their wings are only calculated to carry them a few hours, and after the rising of the sun not one in a thousand is to be found with four wings, unless the morning continues rainy, when here and there a solitary being is seen winging its way from one place to another, as if solicitous only to avoid its numerous enemies, particularly various species of ants which are hunting on every spray, on every leaf, and in every possible place, for this unhappy race, of which probably not a pair in many millions get into a place of safety, fulfil the first law of nature, and lay the foundation of a new community. —Not only all kinds of ants, birds, and carnivorous reptiles, as well as insects, are upon the hunt for them, but the inhabitants of many countries, and particularly of some parts of Africa, eat them.

The greater part have no wings, but they run exceeding fast, the males after the females; I have sometimes remarked two males after one female, contending with great eagerness who should win the prize, regardless of the innumerable dangers that surrounded them.

It is remarkable of all these different species, that the working and the fighting insects never expose themselves to the open air; but either travel under ground, or within such trees or substances as they destroy, except, indeed when they cannot proceed by their latent passages, and find it convenient or necessary to search for plunder above ground; in that case they make pipes of that material with which they build their nests. The larger sort use the red clay; the turret builders use the black clay; and those which build in the trees employ the same ligneous substances of which their nests are composed.

The termites, except their heads, are exceeding soft, and covered with a very thin and delicate skin; being blind, they are no match on open ground for the ants who can see, and are all of them covered with a strong horny shell not easily pierced, and are of dispositions bold, active, and rapacious. Whenever the termites are dislodged from their covered ways, the various species of the former, who probably are as numerous above ground as the latter are in their subterraneous passages, instantly seize and drag them away to their nests, to feed the young brood.

The termites arborum, those which build in trees, frequently establish their nests within the roofs and other parts of houses, to which they do considerable damage, if not timely extirpated. The large species are, however, not only much more destructive, but more difficult to be guarded against, since they make their approaches chiefly under ground, descending below the foundations of houses and stores at several feet from the surface, and rising again either in the floors, or entering at the bottoms of the posts, of which the sides of the buildings are composed, bore quite through them, following the course of the fibres to the top, or making lateral perforations here and there as they proceed.

They are not less expeditious in destroying the shelves, wainscoting, and other fixtures, of an house, than the house itself. They are for ever piercing and boring in all directions, and sometimes go out of the broadside of one post into that of another joining to it; but they prefer, and always destroy, the softer substances the first, and are particularly fond of pine, and fir-boards, which they excavate

and carry away with wonderful dispatch and astonishing cunning; for, except a shelf has something standing upon it, as a book, or any thing else which may tempt them, they will not perforate the surface, but artfully preserve it quite whole, and eat away all the inside, except a few fibres which barely keep the two sides connected together, so that a piece of an inch-board which appears solid to the eye will not weigh much more than two sheets of pasteboard of equal dimensions, after these animals have been a little while in possession of it. When they attack trees and branches in the open air, they sometimes vary their manner of doing it. If a stake in a hedge has not taken root and vegetated, it becomes their business to destroy it. If it has a good sound bark round it, they will enter at the bottom, and eat all but the bark, which will remain, and exhibit the appearance of a solid stick, (which some vagrant colony of ants or other insects often shelter in till the winds disperse it;) but, if they cannot trust the bark, they cover the whole stick with their mortar, and it then looks as if it had been dipped into thick mud that had been dried on. Under this covering they work, leaving no more of the stick and bark than is barely sufficient to support it, and frequently not the smallest particle; so that upon a very small tap with your walking stick, the whole stake, though apparently as thick as your arm, and five or six feet long, loses its form, and, disappearing like a shadow, falls in small fragments at your feet.

ON THE ART OF PLANTING.

THE first thing in planting is to prepare the ground before the trees or plants are taken out of the earth, that they may remain out of the ground as short a time as possible; and the next is, to take up the trees or plants, in order to their being transplanted. In taking up the trees, carefully dig away the earth round the roots, so as to come at their several parts to cut them off; for, if they are torn out of the ground without care, the roots will be broken and bruised, to the great injury of the trees. When you have taken them up, the next thing is to prepare them for planting by pruning the roots and heads. And first, as to the roots; all the small fibres are to be cut off, as near to the place from whence they are produced as may be, except they are to be replanted immediately after they are taken up. Then prune off all the bruised or broken roots, all such as are irregular and cross each other, and all downright roots, especially in fruit-trees: shorten the larger roots in proportion to the age, the strength, and nature, of the tree; observing that the walnut, mulberry, and some other tender-rooted kinds, should not be pruned so close as the more hardy sorts of fruit and forest trees: in young fruit-trees, such as pears, apples, plums, peaches, &c. that are one year old from the time of their budding or grafting, the roots may be left only about eight or nine inches long; but in older trees, they must be left of a much greater length: but this is only to be understood of the larger roots; for the small ones must be chiefly cut quite out, or pruned very short. The next thing is the pruning of their heads, which must be differently performed in different trees; and the design of the trees must also be considered. Thus, if they are designed for walls or espaliers, it is best to plant them with the greatest part of their heads, which should remain

remain on till they begin to shoot in the spring, when they must be cut down to five or six eyes, at the same time taking care not to disturb the roots. But, if the trees are designed for standards, you should prune off all the small branches close to the place where they are produced, as also the irregular ones which cross each other; and, after having displaced these branches, you should also cut off all such parts of branches as have by any accident been broken or wounded; but by no means cut off the main leading shoots which are necessary to attract the sap from the root, and thereby promote the growth of the tree. Having thus prepared the trees for planting, you must now proceed to place them in the earth: but first, if the trees have been long out of the ground, so that the fibres of the roots are dried, place them eight or ten hours in water, before they are planted, with their heads erect, and the roots only immersed therein; which will swell the dried vessels of the roots, and prepare them to imbibe nourishment from the earth. In planting them, great regard should be had to the nature of the soil: for, if that be cold and moist, the trees should be planted very shallow; and, if it be a hard rock or gravel, it will be better to raise a hill of earth where each tree is to be planted, than to dig into the rock or gravel, and fill it up with earth, as is too often practised, by which means the trees are planted as it were in a tub, and have but little room to extend their roots. The next thing to be observed is, to place the trees in the hole in such a manner that the roots may be about the same depth in the ground as before they were taken up; then break the earth fine with a spade, and scatter it into the hole, so that it may fall in between every root, that there may be no hollowness in the earth: then, having filled up the hole, gently tread down the earth with your feet, but do not make it too hard; which is a great fault, especially if the ground be strong or wet. Having thus planted the trees, they should be fastened to stakes driven into the ground to prevent their being displaced by the wind, and some mulch laid upon the surface of the ground about their roots; as to such as are planted against walls, their roots should be placed about five or six inches from the wall, to which their heads should be nailed to prevent their being blown up by the wind. The seasons for planting are various, according to the different sorts of trees, or the soil in which they are planted. For the trees whose leaves fall off in winter, the best time is the beginning of October, provided the soil be dry; but, if it be a very wet soil, it is better to defer it till the latter end of February, or the beginning of March: and for many kinds of evergreens, the beginning of April is by far the best season; though they may be safely removed at Midsummer, provided they are not to be carried very far; but should always make choice of a cloudy wet season.

In the second volume of the papers, &c. of the Bath Society, there is a letter on planting waste grounds. The gentleman who writes it informs us, that in the county of Norfolk, where he resides, there were about sixty or seventy years ago vast tracts of uncultivated ground, which were then thought totally barren. "The western parts of it (says he) abounded with sand of so light a texture, that they were carried about by every wind; and in many places the sands were so loose that no grass could grow upon them. Art and industry, however, have now so altered the face of this

once Arabian desert, that it wears a very different appearance. Most of these tracts are either planted or rendered very good corn-land and sheep-walks.

"About thirty years since, the sides of many of our little sand-hills were sown with the seeds of French furze, and, when a wet season followed, they succeeded very well, and grew so fast, that once in three or four years they are cut for fuel, and sell at a good price at Thetford, Brandon, Harling, Swaffham, and places adjacent. This excited some public-spirited gentlemen, among whom was the late Mr. Buxton, of Shadwell-lodge, near Thetford, to attempt the planting of Scotch and spruce firs, and other hardy forest-trees. At first they found some difficulty from the extreme looseness of the sand. But, as there is in all this part of the country fine white and yellow marle at about three feet depth below the sand, they very judiciously thought that incorporating it with the sand in the holes where their young trees were planted, would insure success; nor were they disappointed. The method succeeded beyond expectation; the plantations thrive exceedingly, and the roots soon reached below the sand, after which they were out of danger. This excited them to further attempts.

"On the spots where they intended to raise new plantations from seeds and acorns, they laid on a thick coat of marle and clay, which after being rough spread, and lying a winter in that state, was made fine, and ploughed in just before planting. By these means the soil became fixed, and in a little time covered with grass and herbage; so that there are now vast plantations of firs, oak, and forest-trees, in the most healthy and vigorous state, where within my memory ten acres of land would not maintain a single sheep three months.

"But the benefit of plantations, whether of shrubs, copse, or trees, is not confined to the immediate advantage, or even the future value of the wood. By annually shedding a great number of leaves, which the winds disperse, and the rains wash into the soil, it is considerably improved; and whenever such copses have been stubbed up, the ground (however unfruitful before planting) has thereby been so enriched as to bear excellent crops for many years, without the additional help of manure. How much land-owners are interested in planting waste or barren spots I need not mention; and nothing but a degree of indolence or ignorance unpardonable in this enlightened age could induce them to neglect it.

"Nature has furnished us with plants, trees, and shrubs, adapted to almost every soil and situation; and, as the laws of vegetation are now much better understood than formerly, it is a reproach to those whose practice does not keep pace with their knowledge in making the best use of her bounty. Let no man repine, and say *the land is barren*; for those spots, which appear to be so, owe that appearance to human negligence. Industry and art might soon render an eighth part of this kingdom nearly as valuable as the rest, which now remains in a state unprofitable to the owners, and disgraceful to the community."

There is a method of reverse planting, in which the natural position of the plant or shoot is inverted; the branches being set into the earth, and the root reared into the air. Dr. Agricola mentions this monstrous method of planting, which he found to succeed very well in most or all sorts of fruit-trees, timber-trees, &c.

Bradley

Bradley affirms, that he has seen a lime-tree in Holland growing with its first roots in the air, which had shot out branches in great plenty, at the same time that its first branches produced roots and fed the tree. Mr. Fairchild of Hoxton has practised the same with us, and gives the following directions for performing it:—Make choice of a young tree of one shoot, of alder, elm, willow, or any other tree that easily takes root by laying; bend the shoot gently down into the earth, and so let it remain until it has taken root. Then dig about the first root, and raise it gently out of the ground, till the stem be nearly upright, and stake it up. Then prune the roots, now erected in the air, from the bruises and wounds they received in being dug up; and anoint the pruned parts with a composition of two ounces of turpentine, four ounces of tallow, and four ounces of bees wax, melted together, and applied pretty warm. Afterwards prune off all the buds or shoots that are upon the stem, and dress the wounds with the same composition, to prevent any collateral shootings, that might spoil the beauty of the stem.

OF THE NATURE AND EFFECTS OF POISONS.

THERE are many different kinds of poisons, which are exceedingly various in their operations. The mineral poisons, as arsenic and corrosive mercury, seem to attack the solid parts of the stomach, and to produce death by eroding its substance: the antimonials seem rather to attack the nerves, and to kill by throwing the whole system into convulsions; and in this manner also most of the vegetable poisons seem to operate. All of these, however, seem to be inferior in strength to the poisons of some of the more deadly kinds of serpents, which operate so suddenly that the animal bit by them will be dead before another that had swallowed arsenic would be affected.

Much has been written concerning a poison made use of by the African negroes, by the Americans, and by the East Indians. To this very strange effects have been ascribed. It has been said that by this poison a man might be killed at any certain time; as, for instance, after the interval of a day, a week, a month, a year, or even several years. These wonderful effects, however, do not seem worthy of credit; as the Abbé Fontana has given a particular account of an American poison called *ticunas*, which in all probability is the same with that used in Africa and the East Indies; and from his account it is extremely improbable that any such effects could be produced with certainty.

With this poison the abbé was furnished by Dr. Heberden. It was closed and sealed up in an earthen pot inclosed in a tin case. Within the tin case was a note containing the following words:—“Indian poison, brought from the banks of the river of the Amazon by Don Pedro Maldonado. It is one of the sorts mentioned in the Philosophical Transactions, vol. 47. No. 12.” In the volume of the Philosophical Transactions here quoted, mention is made of two poisons little different in their activity; the one called the poison of Lamas, and the other of Ticunas. The poison in the earthen vessel used by the Abbé Fontana was that of the ticunas; he was also furnished with a number of American arrows dipped in poison, but whether that of the lamas or ticunas he could not tell.

The

The author begins his account of the nature of this poison with detecting some of the mistakes which had been propagated concerning it.—It had been asserted, that the Ticunas poison proves noxious by the mere effluvia, but much more by the steam which exhales from it in boiling or burning: that, among the Indians, it is prepared only by women condemned to die; and that the mark of its being sufficiently prepared is when the attendant is killed by its steam. All these assertions are by the abbé refuted in the clearest manner. He exposed a young pigeon to the smell of the poison when the vessel was opened, to the steam of it when boiling, and to the vapour of it when burning to the sides of the vessel, without the animal's being the least injured; on which, concluding that the vapours of this poison were not to be dreaded, he exposed himself to them without any fear.

This poison dissolves very readily even in cold water, and likewise in the vegetable and mineral acids. With oil of vitriol it becomes as black as ink, but not with the rest of the acids. In oil of vitriol it also dissolves more slowly than in any of the rest. It does not effervesce with acids or alkalies; neither does it alter milk, nor tinge it except with the natural colour of the poison; nor does it tinge the vegetable juices either red or green. When examined by the microscope, there is no appearance of regularity or crystallization; but it for the most part appears made up of very small, irregular, roundish bodies, like vegetable juices. It dries without making any noise, and has an extremely bitter taste when put upon the tongue.

The ticunas poison is harmless when put into the eyes; nor is it fatal when taken into the stomach, unless the quantity is considerable. Six grains of the solid poison, dissolved in water, killed a young pigeon which drank it in less than twenty minutes. Five grains killed a small Guinea-pig in twenty-five minutes. Eight grains killed a rabbit in an hour and eight minutes, &c. In those experiments it was observed that much less poison was required to kill an animal whose stomach was empty than one that had full stomach. Three rabbits and two pigeons were killed in less than thirty-five minutes by taking a dose of three grains each on an empty stomach; but, when the experiment was repeated on five animals with full stomachs, only one of them died.

The most fatal operation of this poison is when mixed with the blood. The smallest quantity, injected into the jugular vein, killed the animal as if by a stroke of lightning. When applied to wounds in such a manner that the flowing of the blood could not wash it away, the animal fell into convulsions and a train of fatal nervous symptoms, which put an end to its life in a few minutes. Yet, notwithstanding these seeming affections of the nerves, the poison proved harmless when applied to the naked nerves themselves, or even to the medullary substance of them slit open.

The strength of this poison seems to be diminished, and even destroyed, by mineral acids, but not at all by alkalies or ardent spirits; but, if the fresh poison was applied to a wound, the application of mineral acids immediately after could not remove the pernicious effects. So far, indeed, was this from being the case, that the application of nitrous acid to the wounded muscle of a pigeon killed the animal in a short time without any poison at all.—The effects of the arrows were equally fatal with those of the poison itself.

itself. Mr. Paterfon, in his Travels in Africa, in the years 1777-8-9, fell in with an European woman who had been wounded with a poisoned arrow. Great pains had been taken to cure her, but in vain; for at different periods of the year an inflammation came on, which was succeeded by a partial mortification. She told him that the wound was easily healed up; but in two months afterwards there was a certainty of its breaking out again, and this had been the case for many years. The Hottentots poison their arrows with a species of euphorbia. The amaryllis disticha, a large bulbous plant growing about the Cape of Good Hope, called mad poison, is used for the same purpose. The natives take the bulbs when they are putting out their leaves, cut them transversely, extract a thick fluid, and keep it in the sun till it acquires the consistence of gum, when it is fit for use. With arrows poisoned with this gum they kill antelopes, and other small animals intended for food. After they are wounded, the animals generally run for several miles, and are frequently not found till next day. When the leaves of this plant are young, the cattle are very fond of them, though they occasion instant death. Mr. Paterfon mentions another shrubby plant producing a nut, called by the Dutch *woolf gift* or wolf poison, the only poison useful to the European inhabitants. The nuts are roasted like coffee, pulverized, and stuffed into some pieces of meat or a dead dog, which are thrown into the fields. By this means the voracious hyenas are generally killed.

The poison of the viper is analogous in its effects to that of the ticunas, but inferior in strength; the latter killing more instantaneously when injected into a vein than even the poison of the most venomous rattlesnake. The abbé has, however, observed a difference in the action of the two poisons upon blood taken out of the body. He cut off the head of a pigeon, and received its blood into two warm conical glasses, to the amount of about eighty drops into each. Into the blood contained in one porringer, he put four drops of water; and into the other four drops of the poison dissolved in water as usual. The event of this experiment was, that the blood, with which the water only was mixed, coagulated in a short time; but that in which the poison was mixed did not coagulate at all. The poison of the viper also hinders the blood from coagulating, but gives it a much blacker tinge than the poison of the ticunas. The poison of the viper also proves certainly fatal when injected into the veins, even in very small quantity; but it produces a kind of grumous coagulation and blackness in the blood when drawn from a vein, though it prevents the proper coagulation of that fluid, and its separation into crassamentum and serum as usual.

In the Philosophical Transactions, No. 335. a number of experiments are given, which shew the effects of many different poisons upon animals; from whence it appears, that many substances which are not at all accounted poisonous, yet prove as certainly fatal when mixed with the blood as even the poison of rattlesnakes, or the ticunas itself.—An ounce of emetic wine, being injected into the jugular vein of a large dog, produced no effect for a quarter of an hour. At the expiration of that space he became sick, had a continual vomiting, and evacuation of some hard excrements by stool. By these evacuations he seemed to be somewhat relieved; but soon grew uneasy, moved from place to place, and vomited again. After

this he laid himself down on the ground pretty quietly ; but his rest was disturbed by a return of his vomiting, and his strength greatly decreased. An hour and an half after the operation he appeared half dead, but was greatly revived by having some warm broth poured down his throat with a funnel. This, however, proved only temporary relief ; for in a short time the vomiting returned, he made urine in great quantity, howled miserably, and died in convulsions.—A dram and an half of sal ammoniac dissolved in an ounce and an half of water, and injected into the jugular vein of a dog, killed him with convulsions almost instantly.—The same effect followed from injecting a dram of salt of tartar dissolved in an ounce of warm water ; but a dram and an half of common salt injected into the jugular produced little other bad consequence than a temporary thirst.—A dram of purified white vitriol, injected into the crural vein of a dog, killed him immediately.—Fifteen grains of salt of urine, dissolved in an ounce of water, and injected into the crural vein of a dog, threw him into such violent convulsions that he seemed to be dying ; nevertheless he recovered from a second dose, though not without a great deal of difficulty : but an ounce of urine made by a man fasting had no bad effect. Diluted aqua-fortis injected into the jugular and crural vein of a dog killed him immediately, by coagulating the blood. Oil of sulphur (containing some quantity of the volatile vitriolic acid) did not kill a dog, after repeated trials : on the contrary, as soon as he was let go, he ran into all the corners of the room searching for meat ; and, having found some bones, he fell to gnawing them with uncommon avidity, as if the acid, by injection into his veins, had given him a better appetite.—Another dog, who had oil of tartar injected into his veins, swelled and died, after suffering great torment. His blood was found florid, and not coagulated.—A dram and a half of spirit of salt diluted with water, and injected into the jugular vein of a dog, killed him immediately. In the right ventricle of the heart the blood was found partly grumous and concentered into harder clots than ordinary, and partly frothy. Warm vinegar was injected without doing any manifest harm.—Two drams of sugar dissolved into an ounce of water were injected into the jugular vein of a dog without any hurt.

These are the results of the experiments where saline substances were injected into the veins. Many acrids proved equally fatal. A decoction of two drams of white hellebore, injected into the jugular vein of a dog, killed him like a stroke of lightning. Another dog was killed in a moment by an injection of an ounce of rectified spirit of wine in which a dram of camphor was dissolved.—Ten drams of highly rectified spirit of wine, injected into the crural vein of a dog, killed him in a very short time : he died quietly, and licking his jaws with his tongue, as if with pleasure. In the vena cava and right ventricle of the heart the blood was coagulated into a great many little clots.—Three drams of rectified spirit of wine injected into the crural vein of a small dog made him apoplectic, and as it were half dead. In a little time he recovered from the apoplexy, and became giddy ; and, when he endeavoured to go, reeled and fell down. Though his strength increased by degrees, yet his drunkenness continued. His eyes were red and fiery ; and his sight so dull that he scarcely seemed to take notice of any thing : and, when he was beaten, he would hardly move. However, in four

hours

hours he began to recover, and would eat bread when offered him; the next day he was out of danger.—Five ounces of strong white-wine injected into the crural vein of a dog made him very drunk for a few hours, but did not produce any other consequences. An ounce of strong decoction of tobacco injected into a vein killed a dog in a very short time in terrible convulsions. Ten drops of oil of sage rubbed with half a drachm of sugar, and thus dissolved in water, did no harm by being injected into the blood.

Mercury, though seemingly void of all acrimony, proves also fatal when injected into the blood. Soon after the injection of half an ounce of this mineral into the jugular vein of a dog, he was seized with a dry short cough which came by intervals. About two days after, he was troubled with a great difficulty of breathing, and made a noise like that of a broken-winded horse. There was no tumour about the root of the tongue or the parotid glands, nor any appearance of a salivation. In four days he died; having been for two days before so much troubled with an orthopnea, that he could sleep only when he leaned his head against something. When opened, about a pint of bloody serum was found in the thorax, and the outside of the lungs in most places was blistered. Some of the blisters were larger, and others smaller, than a pea, but most of them contained mercurial globules. Several of them were broken; and, upon being pressed a little, the mercury ran out with a mixture of a little sanies; but, upon stronger pressure, a considerable quantity of sanies issued out. In the right ventricle of the heart some particles of quicksilver were found in the very middle of the coagulated blood lodged there, and the same thing also was observed in the pulmonary artery. Some blood also was found coagulated in a very strange and unusual manner between the columnæ of the right ventricle of the heart, and in this a greater quantity of quicksilver than any where else. In the left ventricle was found a very tenacious blood, coagulated, and sticking to the great valve, including the tendons of it, and a little resembling a polypus. No mercury could be found in this ventricle by the most diligent search; whence it appears, that the mercury had passed no farther than the extremities of the pulmonary artery, where it had stuck, and occasioned fatal obstructions. In another dog, which had mercury injected into the jugular, it appears to have passed the pulmonary artery, as part of it was found in the cavity of the abdomen, and part also in some other cavities of the body. All the glandules were very turgid and full of liquor, especially in the ventricles of the brain, and all round there was a great quantity of serum.

In like manner, oil of olives proves certainly fatal when injected into the blood. Half an ounce of this, injected into the crural vein of a dog, produced no effect in half a quarter of an hour: but, after that, the animal barked, cried, looked dejected, and fell into a deep apoplexy; so that his limbs were deprived of all sense and motion, and were flexible any way at pleasure. His respiration continued very strong, with a snorting and wheezing, and a thick humour sometimes with blood flowing out of his mouth. He lost all external sense: the eyes, though they continued open, were not sensible of any objects that were put to them; and even the cornea could be touched and rubbed without his being the least sensible of it: his eye-lids had a convulsive motion. The hearing was quite

lost; and in a short time the feeling became so dull, that his claws and ears could be bored with red-hot pincers without his expressing the least sense of pain. Sometimes he was seized with a convulsive motion of the diaphragm and muscles subservient to respiration; upon which he would bark strongly, as if he had been awake: but this waking was only in appearance; for all the time of his barking he continued as insensible as ever. In three hours he died; and on opening his body, the bronchiæ were filled with a thick froth. An ounce of oil of olives injected into the jugular of another dog killed him in a moment; but a third lived an hour after it. He was seized with great sleepiness, snorting, and wheezing, but did not bark like the first. In all of them a great quantity of thick froth was found in the lungs.

Of all poisons those which may be called culinary are perhaps the most destructive, because they are generally the least suspected. All copper vessels, therefore, and vessels of bell-metal, which contains copper, should be laid aside. Even the common earthen-ware, when they contain acids, as in pickling, become very pernicious, as they are glazed with lead, which in the smallest quantity when dissolved is very fatal; and even tin, the least exceptionable of the metals for culinary purposes except iron, is not always quite free of poisonous qualities, it having been found to contain a small portion of arsenic. Mushrooms and the common laurel are also very fatal. The bitter almond contains a poison, and its antidote likewise.—The cordial dram ratafia, much used in France, is a slow poison, its flavour being procured from the kernels of the peach, black cherry stones, &c. The spirit of lauro-cerasus is peculiarly fatal. The adulteration of bread, beer, wine, porter, &c. produces very fatal consequences, and merits exemplary punishment. Next to culinary poisons, the abuse of medicines deserves particular attention.

The most fatal poisons are, arsenic, corrosive mercury, glass of antimony, and lead. What the effects of these substances are when injected into the blood, cannot be related, as no experiments seem to have been made with them in that way, excepting antimony, whose effects have been already mentioned. The effects of opium, when injected into the veins, seem to be similar to its effects when taken by the mouth. Fifty grains of opium, dissolved in an ounce of water, were injected into the crural vein of a cat. Immediately after the operation she seemed much dejected, but did not cry; only made a low, interrupted, and complaining, noise. This was succeeded by trembling of the limbs, convulsive motions of the eyes, ears, lips, and almost all parts of the body, with violent convulsions of the breast. Sometimes she would raise up her head, and seem to look about her; but her eyes were very dull, and looked dead. Though she was let loose, and nothing tied about her neck, yet her mouth was so filled with froth, that she was almost strangled. At last, her convulsive motions continuing, and being seized with stretching of her limbs, she died in a quarter of an hour. Upon opening the body, the blood was found not to be much altered from its natural state.—A dram and an half of opium was dissolved in an ounce and an half of water, and then injected into the crural vein of a lusty strong dog. He struggled violently; made a loud noise, though his jaws were tied; had a great difficulty of breathing, and palpitation of the heart; with convulsive motions of almost all parts of his body.

These

These symptoms were succeeded by a profound and apoplectic sleep. Having untied him, he lay upon the ground without moving or making any noise, though severely beaten. About half an hour after he began to recover some sense, and would move a little when beaten. The sleepiness still decreased; so that in an hour and an half he would make a noise and walk a little when beaten. However he died in four days, after having voided a quantity of fetid excrements, in colour resembling the diluted opium he had swallowed.

The oil of tobacco has generally been reckoned a very violent poison when introduced into the blood; but from the Abbé Fontana's experiments, it appears to be far inferior in strength to the tucunas, or to the bite of a viper. A drop of oil of tobacco was put into a small incision in the right thigh of a pigeon, and in two minutes the animal could not stand on its right foot. The same experiment was repeated on another pigeon, and produced exactly the same effect. In another case, the oil was applied to a slight wound in the breast; three minutes after which, the animal could not stand on the left foot. This experiment was also repeated a second time, with the same success. A tooth-pick, steeped in oil of tobacco, and introduced into the muscles of the breast, made the animal fall down in a few seconds as if dead. Applied to two others, they threw up several times all the food they had eaten. Two others treated in the same manner, but with empty stomachs, made many efforts to vomit.—In general, the vomiting was found to be a constant effect of this poison: but the loss of motion in the part to which the poison is applied, was found to be only accidental. None of the animals died by the application of oil of tobacco. Dr. Leake however asserts the contrary; saying, that this oil, which is used by the Indians in poisoning arrows, when infused into a fresh wound, besides sickness and vomiting, occasions convulsions and death.

The pernicious effects of laurel-water are confirmed by the experiments of the Abbé Fontana; who tells us, that it not only kills in a short time when taken by the mouth, but that, when given in small doses, the animal writhes so that the head joins the tail, and the vertebræ arch out in such a manner as to strike with horror every one who sees it. In order to ascertain the effects of this water when taken into the blood, our author opened the skin of the lower belly of a pretty large rabbit, and made a wound in it about an inch long; and, having slightly wounded the muscles under it in many parts, applied two or three tea-spoonfuls of laurel-water. The animal fell down convulsed in less than three minutes, and died soon after. The experiment was repeated with similar success in other animals; but was always found to act most powerfully, and in the shortest time, when taken by the mouth, or injected by way of clyster. From these experiments, however, he concluded, that laurel-water would kill by being injected into the blood; but in this he was deceived; for two rabbits had each of them a large tea-spoonful injected into the jugular vein, without any inconvenience, either at the time of injection or afterwards. It proved innocent also when applied to the bare nerves, and even when introduced into their medullary substance.

We shall now proceed to give some account of the proper antidotes for each poison; but, from what has been related concerning the extreme activity of some of them, it is evident that in many cases

ses there can be but very little hope. People are most apt to be bitten by serpents in the legs or hands; and, as the poison, from the Abbé Fontana's experiments, appears to act only in consequence of being absorbed into the blood, it is plain, that to prevent this absorption is the chief indication of cure. The Abbé Fontana proposes a ligature: this, if properly applied between the wounded part and the heart, must certainly prevent the bad effects of the poison; but then it tends to produce a disease almost equally fatal, namely, a gangrene of the part; and our author gives instances of animals being thus destroyed after the effects of the poison were prevented; for which reason he prefers amputation. But the good effects of either of these methods, it is evident, must depend greatly on the nature of the part wounded, and the time when the ligature is applied or amputation performed. If the teeth of the serpent, or the poisoned arrow, happen to strike a large vein, the only possibility of escaping instant death is to compress the trunk of the vein above the wounded place, and to enlarge the wound, that the blood may flow freely and in large quantity, in order to wash away the poison, and discharge the infected parts of the blood itself. If this is neglected, and the person falls into the agonies of death, perhaps strongly stimulating medicines given in large doses, and continued for a length of time, may enable nature to counteract the virulence of the poison. For this purpose volatile alkalies seem most proper, as acting soonest; and perhaps a combination of them with either might be advantageous, as by the volatility of that medicine the activity of the alkali would probably be increased. In the Philosophical Transactions we have an account of the recovery of a dog by means of the volatile alkali, when probably he was in a dying condition. This dog indeed seems to have had a remarkable strength of constitution. The poor creature had first taken two ounces of the juice of night-shade, which he bore without any inconvenience. An equal quantity of the juice of hemlock was then given him without effect. He then took a large dose of the root of wolfsbane with the same success. Two drachms of white hellebore root were next given: these caused violent vomitings and purgings, but still he outlived the operation. He was then made to swallow five roots of the colchicum, or meadow saffron, dug fresh out of the earth. The effect of these was similar to that of the white hellebore, but still he did not die. Lastly, he swallowed two drams of opium; and he even outlived this dose. He was first cast into a deep sleep by it; but soon awaked, and was seized with violent vomitings and purgings, which carried off the effect of the opium. Seeing then that the animal had resisted the most violent poisons, it was resolved to try the effects of the bite of a viper; and he was accordingly bit three or four times on the belly a little below the navel by one enraged. The immediate consequence of this was an incipient gangrene in the parts adjoining to the wound, as appeared by the rising of little black bladders filled with a sanious matter, and a livid colour which propagated itself all around. The motion of the heart became very faint and irregular, and the animal lay without strength or sensation, as if he had been seized with a lethargy or apoplexy. In this condition his wound was cupped and scarified, and Venice treacle applied to it. In two hours after this all the symptoms were increased, and he seemed to be nearly dead; upon which half a drachm of
volatile

volatile salt of hartshorn mixed with a little broth was poured down his throat; and the consequence was, that in a short time he was able to stand on his feet and walk. Another dose entirely dispelled his lethargy, and the heart began to recover its strength. However, he continued very weak; and, though he ate no solid meat for three days, yet at the end of that time his strength was evidently increased. The first day he drank water plentifully and greedily, and on the second day he drank some broth. On the third day he began to eat solid meat, and seemed out of danger; only some large and foul ulcers remained on that part of the belly which was bit; but before these were healed he was killed by another dog.

From comparing this with some other observations, it would seem that volatile alkali is the best antidote against all poisons which suddenly kill by a mixture with the blood, and even of some others. Indeed its effects in curing the bite of snakes seems to be put beyond all doubt, by a paper in the second volume of the Asiatic Researches, p. 323. "From the effect of a ligature applied between the bitten part and the heart (says Mr. Williams the author of the paper), it is evident that the poison diffuses itself over the body by the returning venous blood; destroying the irritability, and rendering the system paralytic. It is therefore probable, that the volatile caustic alkali, in resisting the disease of the poison, does not act so much as a specific in destroying its quality, as by counteracting the effect on the system, by stimulating the fibres, and preserving that irritability which it tends to destroy."

But whatever be the mode of its operation, the medicine is unquestionably powerful. Mr. Williams used either the volatile caustic alkali, or eau-de-luce; the former of which he seems to have preferred. Of it he gave sixty drops as a dose in water, and of the eau-de-luce he gave forty, at the same time applying some of the medicine to the part bitten, and repeating the doses as he found occasion. Of seven cases, some of which were apparently very desperate, only one died, and that appears to have been occasioned by bad treatment after the cure. Many of the patients were perfectly recovered in seven or eight minutes, and none of them required more than two hours: On the whole, Mr. Williams says that he "never knew an instance of the volatile caustic alkali failing in its effect, where the patient has been able to swallow it." Dr. Mead asserts, that the alkali counteracts the deadly effects of laurel-water; we have seen its effects in curing the bite of a viper, and of snakes; and from Dr. Wolfe's experiments on hydrophobic patients, it may even claim some merit there. Still, however, there is another method of attempting a cure in such deplorable cases; and that is, by injecting into the veins any thing which will not destroy life, but will destroy the effects of the poison. It is much to be regretted, that in those cruel experiments which we have already related, the intention seems almost always to have been to kill the animal at all events; whereas, it ought to have been to preserve him alive, and to ascertain what medicines could be safely injected into the blood, and what could not, with the effects which followed the injection of different quantities none of which were sufficient to destroy life. But in the way they were managed, scarcely any conclusion can be drawn from them. Indeed it appears that little good is to be expected from this mode; it is mere speculation, and future experiments

periments must shew whether it ever can be used for the cure of poisons, or for any other purposes: its being now totally laid aside, seems to militate strongly against the efficacy of it; besides, the extreme cruelty of the operation will ever be a strong bar to its general introduction.

Dr. Mead, finding that many pretenders to philosophy have called the goodness of the Creator in question, for having formed substances whose manifest and obvious qualities are noxious and destructive, remarks, by way of answer, that they have also salutary virtues. But, besides their physical effects, they are likewise food for animals which afford us good nourishment, goats and quails being fattened by hellebore, starlings by hemlock, and hogs innocently eating henbane; besides, some of those vegetables, which were formerly thought poisonous, are now used in medicine, and future discoveries may probably increase the number. The poison of many vegetables is their only defence against the ravages of animals; and by means of them we are often enabled to defend useful plants from the destroying insect; such as by sprinkling them with essential oil of turpentine; and, by means of some substances poisonous to them, we are enabled to destroy those insects which infest the human body, and the bodies of domestic animals, &c.—As for poisonous minerals, arsenic for example, Dr. Mead observes, that it is not a perfect mineral, but only an active substance, made use of by nature in preparing several metals in the earth, which are of great service to mankind; and, after confirming this by several instances, he concludes by saying, the case will be found much the same in all natural productions of this kind. As for poisonous animals, &c. their noxious qualities may easily be accounted for, by reflecting that it is their only mode of self-defence.

Copper, though when in an undissolved state it produces no sensible effects, becomes exceedingly active when dissolved; and such is the facility with which the solution is effected, that it becomes a matter of some consequence to prevent the metal from being taken into the human body, even in its proper form. It does not, however, appear, that the poison of copper is equally pernicious with those of arsenic or lead: the reason of this is, that it excites vomiting so speedily as to be expelled, even though taken in considerable quantity, before it has time to corrode the stomach. Roman vitriol, which is a solution of copper in the vitriolic acid, has been used as a medicine in some diseases with great success. Verdigrise also, which is another very active preparation of the metal, has been by some physicians prescribed as an emetic, especially in cases where other poisons had been swallowed, in order to procure the most speedy evacuation of them by vomit. Where copper is not used with this view, it has been employed as a tonic and antispasmodic, with which it has been admitted into the Edinburgh Dispensatory under the title of *Cuprum Ammoniacale*. The effects of the metal, however when taken in a pretty large quantity, and in a dissolved state, or when the stomach abounds with acid juices sufficient to dissolve it, are very disagreeable, and even dangerous; as it occasions violent vomitings, pains in the stomach, faintings, and sometimes convulsions and death. The only cure for these symptoms is to expel the poison by vomiting as soon as possible, and to obtain its acrimony; for which purpose drinking warm milk will probably be found

found the most efficacious remedy. In order to prevent the entrance of the poison into the body, no copper vessels should be used in preparing food but such as are either well tinned or kept exceedingly clean. The practice of giving a fine blue or green colour to pickles, by preparing them in copper vessels, ought not to be tolerated; for Dr. Falconer, in a treatise on this subject, assures us, that these are sometimes so strongly impregnated by this method of preparing them, that a small quantity of them will produce a slight nausea.—Mortars of brass or bell-metal ought for the same reason to be avoided, as by this means a considerable quantity of the pernicious metal may be mixed with our food, or with medicines. In other cases, an equal caution ought to be used. The custom of keeping pins in the mouth, of giving copper halfpence to children to play with, &c. ought to be avoided; as thus a quantity of the metal may be insensibly taken into the body, after which its effects must be uncertain.—It is proper to observe, however, that copper is much more easily dissolved when cold than when hot; and therefore the greatest care should be taken never to let any thing designed for food, even common water, remain long in copper vessels, when cold; for it is observed, that, though the confectioners can safely prepare the most acid syrups in clean copper vessels without their receiving any detriment whilst hot, yet, if the same syrups are allowed to remain in the vessels till quite cold, they become impregnated with the pernicious qualities of the metal.

The poison-tree of Java, called in the Malayan language *bohun upas*, is a tree which has often been described by naturalists; but its existence has been very generally doubted, and the descriptions given of it containing much of the marvellous have been often treated as idle fictions. N. P. Foersch, however, in an account of it written in Dutch, asserts that it does exist; and tells us, that he once doubted it as much as any person; but, determined not to trust general opinions, he made the most particular enquiries possible; the result of which was, that he found that it is situated in the island of Java, about twenty-seven leagues from Batavia, fourteen from Soura Charta, the emperor's seat, and about nineteen from Tinkjoe, the residence of the sultan of Java. It is surrounded on all sides by hills and mountains, and the adjacent country for twelve miles round the tree is totally barren. Our author says he has gone all round the spot at about eighteen miles from the centre, and on all sides he found the country equally dreary, which he ascribes to its noxious effluvia. The poison procured from it is a gum, issuing from between the bark and the tree; and it is brought by malefactors who have been condemned to death, but who are allowed by this alternative to have a chance for their life. An old ecclesiastic, our author informs us, dwelt on the outside of the surrounding hills, whose business it was to prepare the criminals for their fate, if death should be the consequence of their expedition. And indeed so fatal is its effluvia, that he acknowledged scarcely two out of twenty returned from above seven hundred he had dismissed.

Mr. Foersch farther tells us, that he had seen several of the criminals who had returned, and who told him, that the tree stands on the borders of a rivulet, is of a middling size, and that five or six young ones of the same kind stand close to it. They could not, however, see any other plant or shrub near it; and the ground was of

brownish sand, full of stones and dead bodies, and difficult to pass. The Malaysians think this tract was thus rendered noxious and uninhabitable by the judgment of God, at Mahomet's desire, on account of the sins of the inhabitants. No animal whatever is ever seen there; and such as get there by any means never return, but have been brought out dead by such of the criminals as have escaped death.

Our author relates a circumstance which happened in the year 1775, to about four hundred families (1600 souls), who refused to pay some duty to the emperor, and who were in consequence declared rebels and banished: they petitioned for leave to settle in the uncultivated parts round Upas: the consequence of which was, that in less than two months their number was reduced to about three hundred souls, who begged to be reconciled to the emperor, and were again received under his protection. Many of these survivors Mr. Foersch saw, and they had just the appearance of persons tainted with an infectious disorder.

With the juice of this tree arrows, lances, and other offensive weapons, are poisoned. With lances thus poisoned, Mr. Foersch observes, that he saw thirteen of the emperor's concubines executed for infidelity to his bed in February 1776. They were lanced in the middle of their breasts; in five minutes after which they were seized with a tremor and starting of the tendons, and in fifteen minutes they were dead. Their bodies were full of livid spots, like those of *petechia*, their faces swelled, colour blue, and eyes yellow, &c. Soon after he saw seven Malaysians executed in the same way, and saw the same effects follow; on which he resolved to try it on other animals, and found the operation similar on three puppies, a cat, and a fowl, none of which survived more than thirteen minutes. He also tried the effects internally on a dog seven months old; the animal became delirious, was seized with convulsions, and died in half an hour. From all which our author concludes, that it is the most violent of all vegetable poisons, and that it contributes greatly to the unhealthiness of the island in which it grows. By means of it many cruel and treacherous murders are perpetrated. He adds, that there exists a sort of cajoe-upas on the coast of Macassar, the poison of which, though not near so violent or malignant, operates partly in the same manner.

To this account our readers will give such a degree of credit as they think due; it is our business however to add, that it has been controverted in all its parts in a memoir of Lambert Nollé, M. D. fellow of the Batavian Experimental Society at Rotterdam. This memoir was procured from John Mathew a Rhyn, who had been twenty-three years, from 1763 to 1786, resident in the island, and therefore had every opportunity of informing himself on the spot. In this memoir we are told, that Foersch's account of the tree is extremely suspicious, from a variety of circumstances: 1. Though he had letters of introduction, he went to no considerable house, and afterwards privately withdrew among the English. 2. When the emperor was asked respecting Foersch, and the facts he relates, he answered, that he had never heard either of him or of the tree. 3. The distances given to mark the situation of the tree are not accurate. 4. The execution of criminals is different from what he represents. 5. The circumstance of several criminals returning when Foersch was there had a suspicious appearance. 6. There exists no such

such tradition, as that the tree was planted there by Mahomet. 7. There were no such disturbances in 1775 as Foersch represents, the tract to which he alludes having submitted to the Dutch East-India Company as early as 1756. 8. The island is not unhealthy, as Foersch asserts; nor are violent or premature deaths frequent. 9. The Javanese are a curious and intelligent people, and of course could not be so ignorant of this tree had it any existence. 10. The assertions and pretended facts of Foersch have no collateral evidence; and every thing which we gather from the accounts of others, or from the history of the people, invalidates them. For these and other reasons, Dr. Nolst concludes, that very little credit is due to the representations of Foersch, and that the island of Java produces no such tree, which, if it really grew there, would be the most remarkable of all trees.

ON THE ART OF MEMORY.

MEMORY is a faculty of the mind, which presents to us ideas or notions of what is past, accompanied with a persuasion that the things themselves were formerly real and present. What we distinctly remember to have perceived, we as firmly believe to have happened as what is now present to our senses.

When we remember with little or no effort, it is called *remembrance* simply, or *memory*, and sometimes *passive memory*. When we endeavour to remember what does not immediately and (as it were) of itself occur, it is called *active memory*, or *recollection*. A ready recollection of our knowledge, at the moment when we have occasion for it, is a talent of the greatest importance. The man possessed of it seldom fails to distinguish himself in whatever sort of business he may be engaged. It is indeed evident, that, when the power of retention is weak, all attempts at eminence of knowledge must be vain; for memory is the primary and fundamental power, without which there could be no intellectual operation. Judgment and ratiocination suppose something already known, and draw their decisions only from experience. Imagination selects ideas from the treasures of remembrance, and produces novelty only by varied combinations. We do not even form conjectures of distant, or anticipations of future, events, but by concluding what is possible from what is past.

Of a faculty so important, many rules have been given for the regulation and improvement; of which the first is, that he who wishes to have a clear and distinct remembrance, should be temperate with respect to eating, drinking, and sleep. The memory depends very much upon the state of the brain; and therefore whatever is hurtful to the latter must be prejudicial to the former. Too much sleep clouds the brain, and too little overheats it; therefore either of these extremes must of course hurt the memory, and ought carefully to be avoided. Intemperance of all kinds, and excess of passion, have the same ill effects; so that we rarely meet with an intemperate person whose memory is at once clear and tenacious.

The liveliest remembrance is not so vivid as the sensation that produced it; and ideas of memory do often, but not always, decay more and more, as the original sensation becomes more and more remote in time. Those sensations and those thoughts have a chance to be long remembered which are lively at first; and those are likely to

be most lively which are most attended to, or which are accompanied with pleasure or pain, with wonder, surprise, curiosity, merriment, and other lively passions. The art of memory therefore, is little more than the art of attention. What we wish to remember we should attend to, so as to understand it perfectly, fixing our view particularly upon its importance or singular nature, that it may raise within us some of the passions above-mentioned. We should also disengage our minds from all other things, that we may attend more effectually to the object we wish to remember. No man will read with much advantage who is not able at pleasure to evacuate his mind, or who brings not to his author an intellect defecated and pure, neither turbid with care nor agitated with pleasure. If the repositories of thought are already full, what can they receive? If the mind is employed on the past or the future, the book will be held before the eyes in vain.

Some ancient writers speak of an artificial memory, and lay down rules for attaining it. Simonides the poet is said first to have discovered this, or at least to have given the occasion for it. The story they tell of him is this:—Being once at a feast, he was called out, having been told that two young men were without, and must needs speak with him. He had scarcely got out of the house, when the room where the company was fell down, killed all the persons in it, and so maimed the bodies, that, when the rubbish was thrown off, they could not be known one from another: upon which Simonides, recollecting the place where every one had sat, by that means distinguished them. Hence it came to be observed, that to fix a number of places in the mind in a certain order, was a help to the memory:—as we find by experience, that, upon returning to places once familiar to us, we not only remember them, but likewise many things we both said and did in them. This action therefore of Simonides was afterwards improved into an art; and the nature of it is this:—They bid you form in your mind the idea of some large place or building, which you may divide into a great number of distinct parts, ranged and disposed in a certain order. These you are frequently to revolve in your thoughts, till you are able to run them over one after another without hesitation, beginning at any part. Then you are to impress upon your mind as many images of living creatures, or any other sensible objects which are most likely to affect you, and be soonest revived in your memory. These, like characters in short-hand, or hieroglyphics, must stand to denote an equal number of other words, which cannot so easily be remembered. When therefore you have a number of things to commit to memory in a certain order, all that you have to do is, to place these images regularly in the several parts of your building. And thus they tell you, that, by going over several parts of the building, the images placed in them will be revived in the mind; which of course will give you the things or words themselves in the order you desire to remember them. The advantage of the images seems to be this; that, as they are more likely to affect the imagination than the words for which they stand, they will for that reason be more easily remembered.

END OF THE SECOND VOLUME.

